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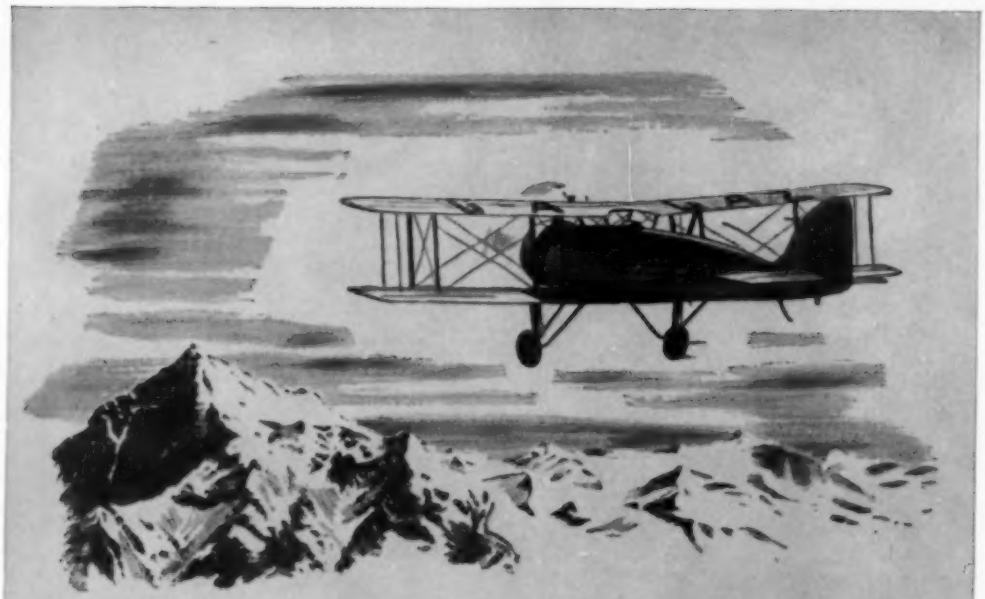

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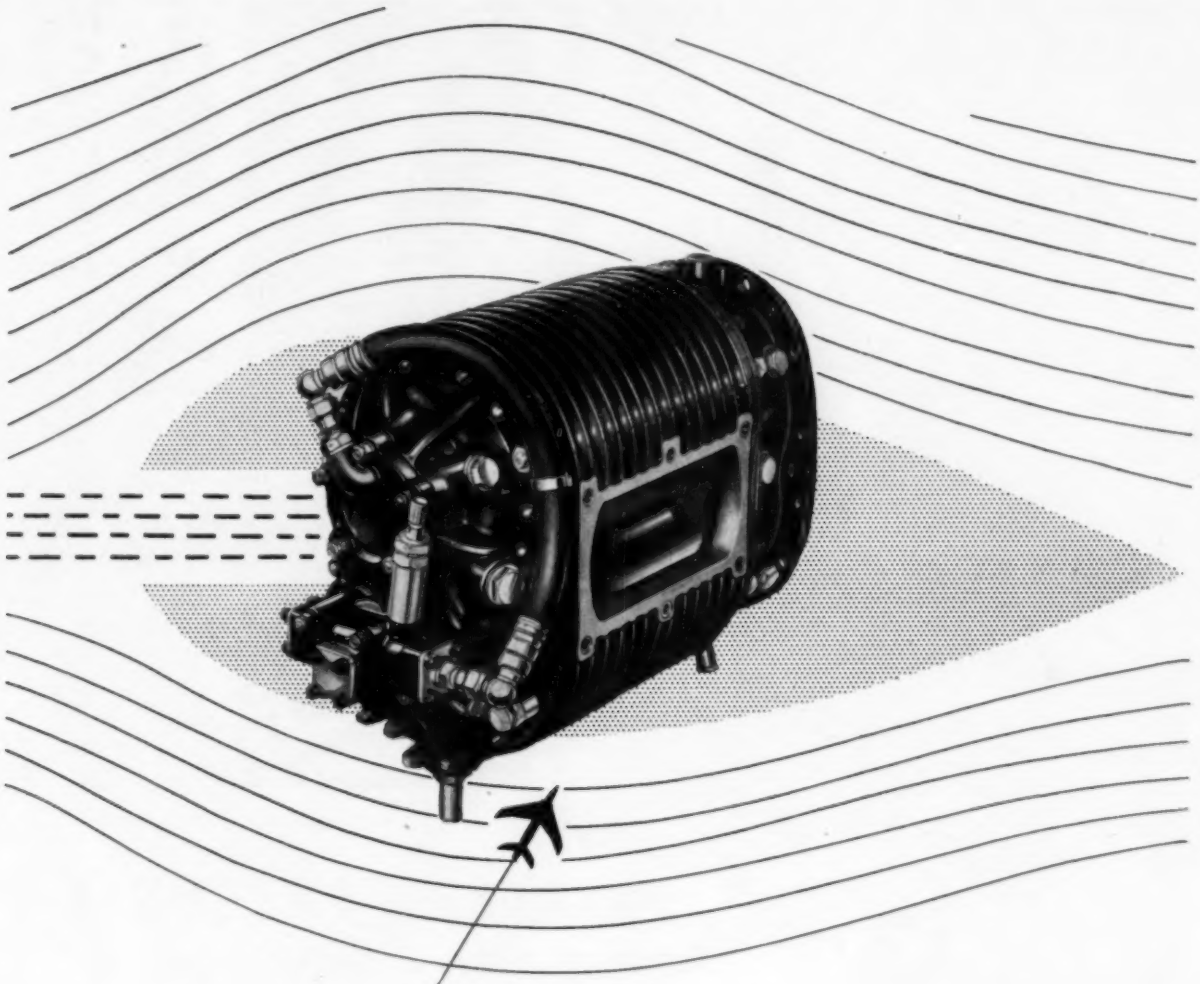

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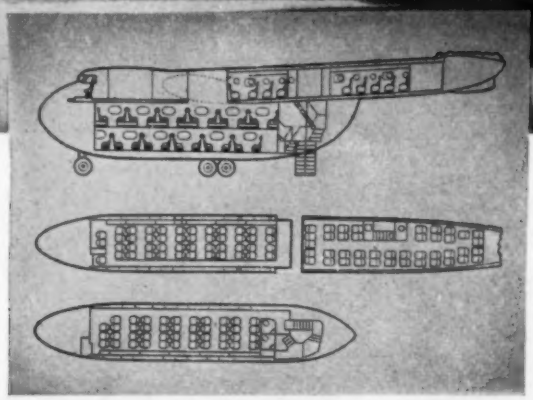

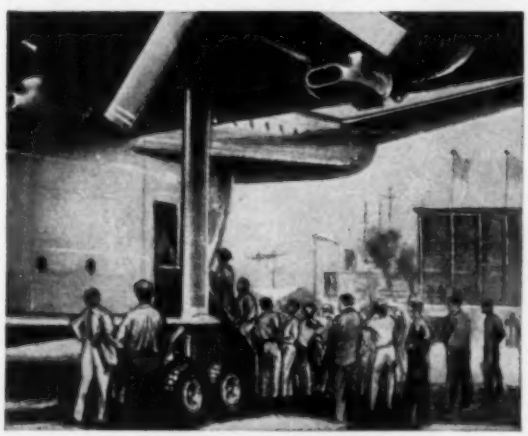

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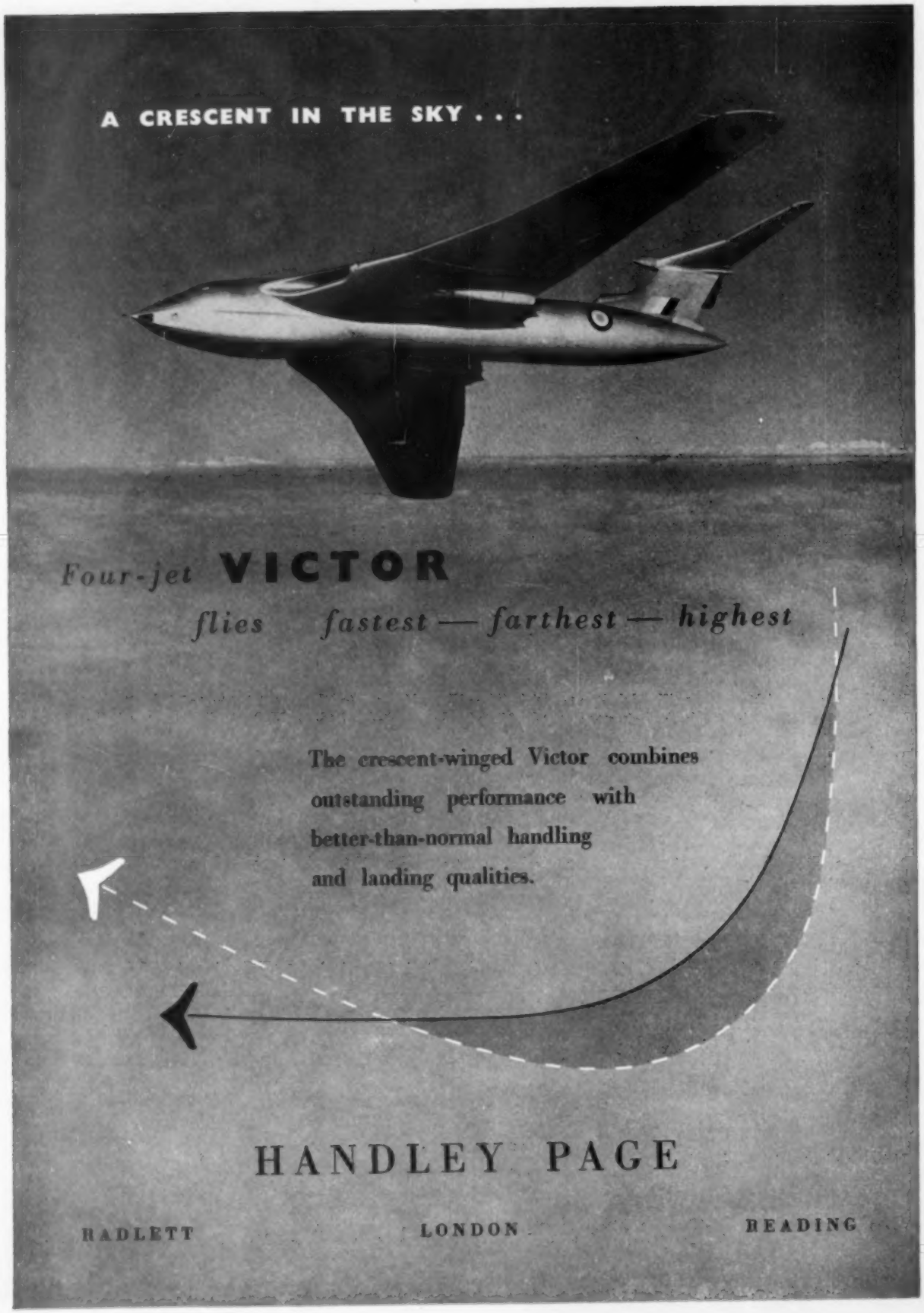
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Exeunt, as Expected

TO remark today that this or that aircraft is slow in reaching service, or that plans to build one design or another are falling behind, is to risk being accused of "trying to get into the act." The curtain rose on the first scene of this particular play, in the House of Lords. Lord Trenchard spoke the words and the date was July, 1953. Since then, several principals have taken the stage, more than one bearing a quite legitimate axe for grinding. The finale is likely to be an anti-climax, for the realization will come that there is no short cut or economical way of achieving quick results. With Mars on the wane, the characters will retire severally—dismissed by Treasury but carrying, perhaps, a consolation prize handed to them by Uncle Sam.

In all fairness to the manufacturers it must be stated that with scarcely an exception the time taken to get a given type of aeroplane into service from the word go is almost exactly the same here as in America. It is the decision to say go which is, and has been, the deciding factor so far as the ultimate delivery is concerned.

Whether this is generally realized or not, there has been a great deal of talk about how long we have had to wait for the new bombers and fighters and about the need to plan boldly and in good time for the aircraft to follow them. Having settled the requirement and having managed to decide to place an order, money becomes the over-riding factor controlling speed of building, development and line production.

However, none of the foregoing should be interpreted as meaning that there is a kind of predestination about the ordering, building and development of aircraft and thus that efforts can be spared. It may be difficult to speed up the process, but it is all too easy to let it slow down and, in fact, come to a complete standstill.

At the end of his recent Mitchell Memorial Lecture, Mr. "Joe" Smith said: "I believe myself that Mitchell would have foreseen in good time all these (design) problems rearing their ugly heads, and would have thought out solutions to them. . . . With all his skill and dogged determination I think it possible that he would have greatly exceeded our rate of progress." Designers seldom work entirely in charted seas. The ability of a few to look as far as the horizon, or even a little beyond it, marks them as the outstanding men of their profession. Such as these are seldom taken by surprise. They estimate where others might have to guestimate, and in consequence their aircraft suffer fewer delays and fewer setbacks.

Helicopter Hiatus

ALL our readers will have heard of the B.E.A. Helicopter Unit, and many will be familiar with its work. For several years past—since 1947 in fact—the Unit and its pilots have slowly built up experience, first with American Bell 47s and Sikorsky 51s, and later with British Bristol 171s in addition.

It was this unit which experimented with, and then operated, regular day (and later night) helicopter services; it also operated the first passenger return service, from London to Birmingham, in the world.

Considering the work done and the results obtained, this has not been a costly enterprise. Moreover, others have observed, admired and followed suit. Mail services are running in America, and taxi services between airports and city centres are planned; Sabena are already running regular passenger services in Europe, using single-engined American-designed helicopters (a newspaper report that the Belgian company is planning to operate helicopters to London is entirely inaccurate).

What is the B.E.A. Unit being allowed to do? Practically nothing, we fear. No services, no suitable helicopters; and some of its most experienced pilots have left the fold to take up active helicopting abroad.

We are well aware of B.E.A.'s plans for the future and of the larger commercially economical helicopters being designed or developed in England. But can we afford to wait and will the spirit and experience of the little nucleus manage to survive during this freewheeling (or autorotating) period. We suggest that the position should be carefully considered again. A little more invested now in dollars or on development at home or both might bring in worth-while dividends later on.

FROM ALL QUARTERS

AT ROTORUA: Her Majesty the Queen enters a de Havilland Heron of New Zealand National Airways to fly to Gisborne. In the foreground is Sir Leonard Isitt (chairman of N.Z.N.A.) and at the foot of the gangway is G/C. J. J. Busch.

Aircraft Export Record

AIRCRAFT took second place in Britain's engineering exports last year, their value being exceeded, in the broad category styled "engineering products," only by motor vehicles.

Final 1953 figures, released last week, show that the aircraft industry brought no less than £65,004,891 to this country. This is an increase of some £20 million over the total for the previous year, when, for the first time, the aircraft figures exceeded the value of British shipbuilders' exports and came into third place among all classes of engineering exports. The new aircraft total represents 6.4 per cent of the overall figure for engineering exports.

Commenting on this very satisfactory result, the S.B.A.C. remarks it is accounted for partly by the easing of restrictions on the exports of military aircraft made possible by changes in the defence programme, and also by the delivery overseas for the first time of the new turbine airliners. During the year, 13 such airliners were exported.

In the Commons

THAT a considerable programme of research into the problems of "piloted supersonic flight" was being undertaken was stated to the House of Commons on Monday last, February 1st, by Mr. Duncan Sandys, the Minister of Supply.

He said that a number of different types of supersonic Service aircraft were in course of development. He was not free to go into details. This question-time reply (which added nothing to existing knowledge) appeared to surprise Mr. Beswick (Lab., Uxbridge). Presumably Mr. Beswick had intended his question to the Minister to imply supersonic *level* flight.

Several other matters of aviation interest were raised in the House on Monday.

An assurance that manufacturing agreements with the United States in the field of aircraft engineering were proving to be mutually satisfactory was given by Mr. Duncan Sandys. He said that versions of the Tay and Sapphire were being manufactured under licence in America. He could not, of course, disclose production figures for American military engines, as implied in a question by Mr. Beswick.

Mr. Sandys said there was a great deal of interchange of information and development knowledge between the air forces of Britain and America, and it was greatly to the advantage of both countries that this arrangement should continue.

Another question from Mr. Beswick concerned money spent by the Ministry of Supply since the war on engine research and development. He wanted to know the total, and to what extent this money had been recovered after sales by manufacturers.

Mr. Sandys replied that almost all his department's expenditure on engine development had been primarily for military purposes; such information could not, therefore, be published. Until 1950, the amounts recovered from manufacturers in respect of engine sales were not kept separately; but it could be said that these repayments were at present at the rate of about £1,000,000 a year.

Mr. Beswick then drew attention to the recent statement "by the chairman of the biggest group of aircraft manufacturers," who had said that insufficient money was being spent on research and development, and that in fact the Ministry of Supply was now actuated by timidity and complacency. Did the Minister accept these criticisms? Mr. Sandys replied that he did not, and that an answer to these charges had already been given.

Shipping Line Invests in Airwork

PARTNERSHIPS between shipping and air-transport companies seem likely to have an important influence on the future of the British independent airline industry. One such arrangement has recently come into effect; a second was announced on Monday, when Furness, Withy and Co., Ltd., stated that they had agreed to acquire a substantial interest in Airwork, Ltd. S. Pearson Industries, Ltd., and Mr. Loel Guinness retain their existing interests in Airwork, whose board will be strengthened by two nominees of Furness, Withy. This major shipping line and its direct subsidiaries own vessels of 595,000 tons gross and have 11 ships of some 80,000 tons under construction. Airwork, established in 1928, operates Vikings, Hermes and DC-3s.

SABRE SIMULATOR—the first of ten being made by Redifon, Ltd., for the R.C.A.F.—is accepted by A. Cdre. Martin Costello, O.B.E., C.D., from Mr. Paul Adorian, chairman of the company *(see page 144).*

YEOVIL PRODUCTION of Westland-Sikorsky S-55 multi-purpose helicopters (Alvis Leonides engine) is coming along nicely, as this recent picture bears witness. The S-55's Service name will be Whirlwind.

A Hundred Provosts

A CEREMONY at the works of Percival Aircraft last Monday marked the handing-over of the hundredth production Provost trainer to the C-in-C. Flying Training Command, Air Vice-Marshal L. F. Pendred, C.B., M.B.E., D.F.C. Also present were the A.O.C. No. 23 Group, A.V-M. G. D. Harvey, C.B.E., D.F.C.; Director of Flying Training, Air Ministry, A. Cdre. R. C. Mead, C.B.E., D.F.C., A.F.C.; the S.T.S.O. of Flying Training Command, A. Cdre. J. R. Mutch, C.B.; and Mr. H. E. Hancocke, O.B.E., Director of Aircraft Production at the M.o.S. The aircraft was flown by F/L. B. A. Lea to No. 6 F.T.S.

The Provost started its training career in October 1953. The first course actually opened on September 1st, but already at that time there were several machines at Boscombe Down and South Cerney. The two schools at present equipped are Ternhill (No. 6) and Syerston (No. 22); two more to receive Provosts are Feltwell (No. 3) and Cluntoe, Northern Ireland (No. 2).

At a luncheon, with Mr. P. Hunting in the chair, A.V-M. Pendred was introduced by Mr. W. A. Summers. He said that the flying instructors in his Command were "absolutely delighted" with the Provost: "You have given us a trainer which is exactly what we wanted, and I really believe that we got more than we hoped for. You will be glad to hear that it is now proved that my students can go solo in the Provost after less than 12 hours dual, and that is a very great advantage indeed because, as you also know, your Provost is capable of allowing students to carry out more advanced exercises which have hitherto been done on Harvards and Balliols. So the Provost is a dual-purpose trainer with great advantages, and we all love it." He also made a short broadcast to those who had been building the Provost: "I think it is very right," he said, "that you who are making this delightful aircraft should know how pleased we all are who have to teach flying on it." He hoped that hundreds more Provosts would come off the lines up to time, and as beautifully made as the ones they already had. At lunch he said that members of the first course on Provosts were in the nature of "lucky guinea pigs." If they did not transfer easily to Vampire Trainers, he added, it would be the fault of the syllabus, not of the Provost.

Thanking the C-in-C. for his visit, Mr. Hunting also said that the company always welcomed any Service criticisms of its products.

Two Jet Provost prototypes, with Viper engines, are taking shape well at Luton. Incidentally we can confirm positively that this type will *not* be named the Primus.

Five Comet 3s for B.O.A.C.

IT was officially announced last Monday that Sir Miles Thomas, B.O.A.C. chairman, has signed a firm order for five Comet 3s. As long ago as November 1952 the Corporation stated that it had acquired an option on ten Comet 3s, and in November 1953 de Havillands announced B.O.A.C.'s "initial order" for five of these aircraft.

The prototype Comet 3 is due to fly this summer and deliveries to B.O.A.C. and P.A.W.A. (who have ordered three) will begin in 1956. With 58 first-class passengers, the Comet 3 will operate stage-lengths of 2,600 miles.

U.S.A.F. Bases in Britain

ACCORDING to a decision of the American House Appropriations Committee, published on February 1st, the United States is in future to pay a major share of the expenses of construction of U.S.A.F. bases in Britain. So far, 15 of the 19 bases here are partly or fully operational, leaving only those at Elvington, Stansted, Chelveston and Bruntingthorpe inoperative. Of the costs, the United States will contribute $276m (£98m) in cash and $22m (near £8m) in labour, while Britain will pay $63 (£22m) in cash and provide the land and $209m (£74m) in facilities. The U.S.A.F. will also have the use of a 400-mile wartime pipeline. All this does not imply that Britain's share of expenditure has been reduced; as the State Department admitted last Monday, it is bigger than was originally envisaged.

"Wings" Ball in Switzerland

TOMORROW, Saturday, February 6th, another "Wings" Ball organized by the Royal Air Forces Association is to be held in Switzerland—at the Palace Hotel, St. Moritz. This morning, Friday, a Dakota chartered from Silver City Airways is due to leave for Zurich carrying a load of a highly "V.I.P." nature: it will include Marshal of the Royal Air Force Lord Tedder, Lady Tedder, test pilots Neville Duke, Michael Lithgow and Leslie Colquhoun, actress Marie Burke and the R.A.F. Dance Band.

The choice of St. Moritz is appropriate, for the ball is to raise funds to provide comforts for ex-Service patients now receiving treatment in Swiss sanatoria. Such treatment is often a lengthy business, and the R.A.F.A. wants to make the patients as comfortable as possible during their absence from Britain, especially as some can receive little help of this kind from home.

THE HUNDREDTH PROVOST: This group was photographed at the Luton handing-over ceremony described on this page. Left to right: Mr. L. G. Friese (Percivals), A. Cdre. R. C. Mead, F/L. B. A. Lea, A. Cdre. J. R. Mutch, A. V-M. G. D. Harvey, A. V-M. L. F. Pendred, Mr. P. L. Hunting (Chairman, Hunting Aviation Group), and Mr. W. A. Summers (Managing Director, Percivals), Mr. H. E. Hancocke (M.o.S.) and K. D. Morgan (Percivals).

R.Ae.C. Award Winners

AS recorded on page 166 of this issue, winners of Royal Aero Club Trophies and Gold and Silver Medals for 1953 were briefly announced at the Club dinner in honour of S/L. Jimmy Rush. The recipients, whose portraits appear below, are as follows:

The Britannia Trophy for 1953 has been awarded to S/L. R. L. E. Burton and F/L. D. H. Gannon, winners in their Canberra of the speed section of the England-New Zealand Air Race. **Royal Aero Club Gold Medals** are awarded to W/C. W. F. Gibb, who established a height record of 63,668ft in an Olympus-powered Canberra in May; to S/L. Neville Duke, for his world speed record at Littlehampton in the Hawker Hunter on September 7th (727.6 m.p.h.) and his speed record over a 100 km closed circuit at Dunsfold on September 19th (709.2 m.p.h.); and to Lt. Cdr. M. J. Lithgow, for his world speed record in the Supermarine Swift in Libya on September 25th (735.7 m.p.h.). A **Royal Aero Club Silver Medal** is awarded to W/C. R. McIntosh for his contribution to civil and sporting aviation over a period of 35 years. **The Geoffrey de Havilland Trophy** is awarded to Lt. Cdr. Lithgow for his speed record. (This Trophy goes to the British pilot who in each year achieves the highest speed in any official race or record attempt.)

The Gold Medals and the Geoffrey de Havilland Trophy are to be presented on February 24th and the Britannia Trophy on March 31st.

BRITANNIA TROPHY RECIPIENTS for 1953 (as recorded in a paragraph above) are (top) Lt. Cdr. M. J. Lithgow (Vickers Supermarine) and W/C. W. F. Gibb (Bristol); (centre) S/L. Neville Duke (Hawker) and W/C. R. McIntosh (Airwork); and—last in the gallery—F/L. D. H. Gannon (left) and S/L. R. L. E. Burton.

SIMULATING THE SABRE

First Redifon F-86E Simulator Handed Over to the R.C.A.F.

THE contract under which ten Sabre simulators are to be delivered to the R.C.A.F. was awarded to Redifon, Ltd., in the face of strong competition, in July 1952. Its value is 3,500,000 Canadian dollars (over £1¼m) and the granting was conditional upon the first simulator being delivered in eighteen months. The contract is part of Canada's contribution to the European defence programme.

This first equipment, of the mobile type, was handed over last week at a ceremony at the makers' Webber Street, London, premises, A. Cdre. Martin Costello, O.B.E., C.D. (deputizing for A. V-M. Campbell), accepting it on behalf of the R.C.A.F. from Mr. Paul Adorian, Redifon chairman.

The great value of these simulators lies in the fact that they save money by reducing the aircraft flying hours required for training, and also allow periodical checks and instrument-flying practice to be carried out. Emergency procedures can also be practised in safety. There is no suggestion, of course, that simulators can take the place of more than a proportion of the hours required for familiarization and practice.

The cost of operating the Sabre simulator is said to be a little under £3 per hour, compared with the aircraft cost of at least £150 per hour. A simulator can be operated for 15 hours a day, irrespective of weather conditions, and it has been calculated that by its use up to 16 Sabre flying hours can be saved during the training of a Service pilot to operational standard. On a squadron with an average complement of 25 pilots, the saving is approximately 30 flying hours per man per year. The R.C.A.F. expects to save a total of some 3½ million dollars a year when all the simulators are in service.

An excellent summing-up of the value of the simulator was given at the handing-over ceremony by A. Cdre. Costello. He said that in recent years the complexity of the modern aeroplane had become a major problem, and that with this complexity had come an increase in the value of the machines that was now measured in figures which were undreamed of only a few years ago. In a similar manner, the responsibility placed on each individual pilot had grown.

"To meet this," he continued, "we are faced with the need for a most careful selection of the men who will be trained to fly, and a far more extensive training programme than was necessary a few years ago. In the case of the Sabre in the R.C.A.F., a great deal of this training must at present be carried out in the air, using fully operational aircraft. This is indeed an expensive necessity and even this training has its limitations, because no instructor can be carried in the aircraft and, when things go wrong, an instructor's personal observation of the pilot's ability is lacking.

"This simulator has been designed to fill these needs. It is a big step forward in pilot training and has the potential to improve the fighting qualities of our pilots, to reduce the accident rate, to save aircraft and perhaps even lives. With the simulator, any fault in a pilot's technique is quickly exposed. The pilot works under simulated conditions approaching actual flight . . . The instructor can introduce any type of technical fault he may wish and watch the pilot's reaction.

"The full complement of these simulators in the R.C.A.F. can save the costs of certain aspects of pilot training which, when added together over a period of a year, will equal the cost of the total simulator contract."

A few details of the intended distribution of the ten simulators have been disclosed by the R.C.A.F. It is planned to provide two of the mobile installations for fighter wings serving in Europe and two static simulators for the No. 1 Fighter Operational Training Unit at Chatham, New Brunswick. The first simulator will be delivered to No. 1 Fighter Wing, at North Luffenham, Rutland. (The R.C.A.F. now have four fighter wings operating Sabres in Europe, making up a 12-squadron air division.) Personnel will be trained by Redifon, Ltd., in the servicing of the simulators, and the first 12 men are now on a course at the company's works.

"Flying" the Simulator. A member of the staff of *Flight* has had the opportunity of making a brief trial of the Redifon

Inside the simulator vehicle, 36ft long, are the Sabre cockpit as seen above, the recording panels (left) and the instructor's console (below). In the front of the vehicle, still within the trailer section, are the computers, power unit and air-conditioning plant.

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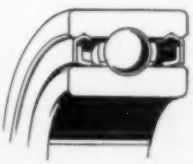

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SIMULATING THE SABRE . . .

Sabre simulator. It is difficult (he writes) to assess the handling of a simulator without having flown the actual aircraft; but it is immediately evident on inspection that this is a comprehensive mechanism. The cockpit is, in fact, an actual section of the F-86E fuselage complete with all its fittings.

While the machine is fixed rigidly to its mounting, the instruments respond to control movements. Thus it is possible to carry out aerobatics or normal flight, take-offs and landings without experiencing the physical sensations normally associated with them. At the same time, all sound effects are most convincingly reproduced; and this, coupled with the verisimilitude of the pilot's immediate surroundings, provides a convincing impression of actual flight. Almost any condition can be simulated, whether normal or abnormal.

During the short trial I felt that the flying controls had the putty-like feel of a static aircraft; but how much this is characteristic of the artificial feel of the Sabre's own irreversible control system it is difficult to judge. It would be interesting to know how the stick-forces actually compare. One suspects that the throttle control reacts slightly sluggishly and a criticism (which can be levelled at any simulator) was that, though response rates were appropriately high, the interval between control movement and instrument reaction was slow—as much as one second.

Without question, the Redifon simulator's outstanding quality is that it approaches as closely as it is possible to do the atmosphere and conditions in a Sabre aircraft. It does have that quality essential for a good static trainer—it is convincing to the pilot. Its main advantage is that it makes it possible to practise safely, conveniently, economically and repeatedly the procedures, drills and sequences required to deal with the numerous minor and major emergencies for which, though he rarely meets them, the pilot must always be prepared.

Applications of Water-based Aircraft

WITH the above heading as his title, G/C. G. W. Williamson, O.B.E., M.C., M.Inst.C.E., M.I.Mech.E., M.I.Prod.E., M.I.E.E., F.R.Ae.S., who is industrial consultant to Short Bros., delivered a lecture before the Royal United Service Institution in London on February 3rd. Coverage included such topics as the atomic submarine, changing conditions in sea warfare, flying-boats for tomorrow, tactical application of, and operational research into, flying-boats, past and present anti-submarine flying-boats, built-in seaworthiness, anti-submarine tactics, and sea warfare and nuclear energy.

Early in his address the group captain recalled that operational research began in this country with the attachment of Professor P. M. S. Blackett, M.A., D.Sc., F.R.S., to Coastal Command in March 1941. The changes made by such experts, he remarked, were often ridiculously simple. For example, some member of the Professor's staff asked why the anti-submarine Whitleys were painted black, and was told that they had been transferred from night bombing to sea warfare. A programme of repainting to the colour of the grey skies resulted in a considerable increase in sightings and sinkings of enemy submarines; it shortened by 20 per cent the time between sighting and attack, and resulted in 30 per cent more sinkings.

Some of the lessons learned from operational research during the war were summarized by the lecturer as follows:

(1) In any other war the convoy system would doubtless be initiated on all seas. The lack of convoys in the Caribbean led, during the last, to the loss of an oil tanker a day—and as there was no A.S.R. service—the crews were lost also.

(2) As air cover reduced the number of escort vessels necessary by at least 50 per cent, the decision would doubtless be made as to the provision of adequate types and numbers of aircraft for this purpose—land-based, carrier-based, or water-based.

(3) Although it was found that submarine sinkings were proportionate to the numbers of aircraft multiplied by the number of hours flown, it would appear that one other important factor was the number of pairs of unfatigued eyes watching not only the sea but the radar. The importance of air cover might be so great that 50 per cent of escort vessels might be replaced by a single escort carrier, with suitable aircraft.

(4) Operational calculations could demonstrate the need for large flying-boats, partly on account of their long endurance when used as air cover for unavoidably small convoys and partly because of the need for some type of air/sea rescue.

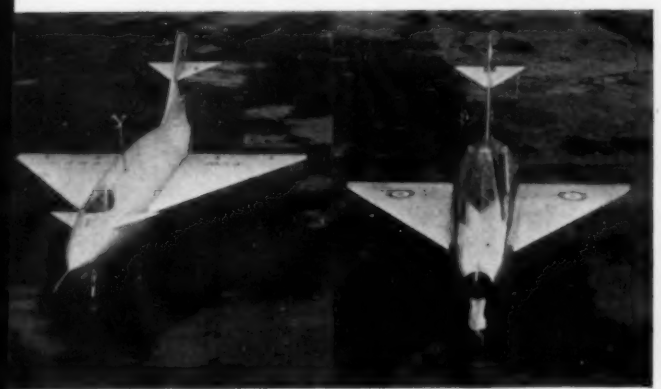
Discussing tactical applications of flying-boats, the group captain remarked that this type of aircraft was used by the U.S. Navy for long-distance patrol, screening, scouting, reconnaissance, mining, anti-shipping, spotting and guided missile work. In any future war torpedoes might be provided with atomic warheads; their range might be several times greater than at present, and, as a pilot might be diffident about dropping an atomic weapon on to the water 20ft below him, it was conceivable that a flying-boat might release the torpedoes while waterborne. Presumably these would be of the homing type and could therefore be discharged at long range. It was also possible that the technique of the miniature submarine might be used. Here again it would not be fair to jettison the crew and their craft while the aircraft was flying at over 100 m.p.h., but miniature submarines could be launched from a flying-boat on the water.

Discussing the type of flying-boat required, the lecturer said that little or no increase in crew efficiency was obtained by increasing size beyond that of the Martin Marlin. This machine, he disclosed, carries a ton of electronics, costing 125,000 dollars, and a dish antenna in the nose—the largest airborne antenna in the world—measuring 5½ft in diameter. The range of search and accuracy of radar spotting was supplemented by the searchlight.

Advanced bases for flying-boats would necessitate special maintenance techniques. Both the United States and—in this country—Saunders-Roe had made airborne pontoons which could be linked together to provide a considerable waterborne surface, and if it were necessary at short notice to load and transport a floating dock to any part of the world, the Princess could carry the components as well as the erection crews. Refuelling could now be done at sea, and the Marlin had a central refuelling point.

Just before the North African landings, the lecturer recalled, the entry of submarines into the Mediterranean was barred by very frequent patrols of aircraft fitted with MAD (Magnetic Airborne Detector). This device constantly indicated the undisturbed lines of force of the earth's magnetic field, but if the aircraft passed over a submarine which had its own magnetic field, disturbance of the earth's field would register on the detector.

RETURN TO THE CANARD?



TRI-ANGULATION: The SFECMAS Gerfaut prototype delta (right) posed opposite its full-scale model—the 1301, with its new nose plane.

AS intimated in an "Aircraft Intelligence" paragraph (page 147), the *canard* ("tail-first") layout shows new signs of life. On this page we are able to publish a picture of the SFECMAS 1402 Gerfaut (Gerfalcon) delta-wing research aircraft alongside the 1301 full-scale research glider, with the latter displaying, for the first time, a nose-plane. This feature has been incorporated to establish the handling characteristics—in particular low-speed and landing behaviour—for the powered machine, even though the two fuselages are far from being aerodynamically similar. The 1301 was formerly used to establish the relative merits of the delta wing and a heavily swept conventional wing, and the new layout suggests investigation into the merits of the *canard* delta.

It is thought that the nose-plane will improve both the static stability and control, being farther from the "focal point" of the wing than the tailplane, so giving a longer moment arm and, in theory, leading to a smaller and lighter surface. An inexplicable feature of the 1302 nose-plane is that it appears to be fixed so that it can serve only for damping. The original tailplane is now smaller and the elevators have been removed. The incidence of the nose-plane is greater than that of the mainplane to ensure that it shall stall first and produce a nose-down pitching movement. Presumably, if this feature is successful on the 1301 it will appear also on the Gerfaut.

HERE AND THERE

"SPEAKING OF OTTER PAYLOADS," says the Canadian de Havilland Company, "this impressive body of high-priced help recently descended on Ottawa en masse." The Otter flew the 220 miles from Toronto in 1 hr 42 min; the D.H.C. executives who made the trip are (left to right):— William Ferderber, test pilot; William Calder, service manager; Larry Clarke, contracts manager; Jim Brownell, spares manager; Fred Buller, senior designer; John Hickey, liaison officer; George Neely, executive assistant to managing director; Alex Watson, chief draughtsman; Len Trotter, technical sales manager; R. Wilson, public relations manager.

Long-Range CF-100

DURING a routine long-distance flight to practise the climbing cruise technique in an Avro Canada CF-100, F/Ls. M. Kobierski and D. Turner, of No. 445 Squadron, R.C.A.F., flew 2,100 miles from Vancouver to North Bay in 3 hr 50 min non-stop. They claimed that they had enough fuel left to continue to Uplands, Ontario, but did not attempt it since they were not seeking a record. Their flight is, however, an unofficial distance record for jet fighters without flight refuelling.

Italian-built Bells

THE Italian firm of Giovanni Augusta, of Cascina Costa, Gallarate (Varese), is now well advanced with preparations for the production of Bell helicopters under licence; the type chosen is the 47D.1 and it will be known in Italy as the Augusta-Bell. It is understood, however, that the size of the government order leaves the factory with plenty of capacity for any other work that comes along—a situation too familiar to Italy's aircraft industry.

Club Pilots Join Sea Search

AMONG aircraft which took part in the search for the R.A.F. Washington which was lost in a snowstorm over the Irish Sea on the night of January 25th-26th, while on a flight from Prestwick to the Azores with a crew of seven, were two Austers of the Blackpool and Fylde Aero Club. Though without V.H.F. or blind-flying equipment, the two aircraft were given special clearance and took off at 10.45 a.m., in very bad visibility, to search the sea from ten miles west of Fleetwood to south of the Ribble. They were flown by Mr. Gordon Edmundson, one of the club instructors, and F/L. J. S. Lowery.

Sir Frank Whittle Joins B.P.M.

RUMOURS that A. Cdre. Sir Frank Whittle was to take a post in America are apparently ended by the news that he has joined Bataafsche Petroleum Maatschappij, of The Hague, one of the principal companies of the Royal Dutch Shell group. According to a Shell announcement, he "will give advice in the field of mechanical engineering relative to the techniques and equipment in the petroleum and chemicals-from-petroleum industries."

Canberra Record Confirmed

THE London to Cape Town and return records made by an R.A.F. Canberra (Rolls-Royce Avons) last December have now been confirmed by the F.A.I. The accepted figures show that the city-centre distance of 6,009.8 statute miles was covered in 12 hr 21 min 3.8 sec (486.6 m.p.h.) outward and 13 hr 16 min 25.2 sec (452.8 m.p.h.) homeward. Two crews made the flights; on the first were W/C. C. G. Petty, S/L. T. P. McGarry and S/L. J. M. Craig; on the second were W/C. A. H. Humphery, S/L. D. Bower and S/L. R. F. B. Powell.

R.A.E. College Prize-giving

FORMERLY Director of the Royal Aircraft Establishment (and now technical director of A. V. Roe and Co., Ltd., and president of the Royal Aeronautical Society), Sir William S. Farren presented the prizes for the 1952-53 session of the R.A.E. Technical College. The presentation took place last Monday at Farnborough and was followed by the College's annual dinner and dance.

Sycamore Tail Rotors

OPERATORS of Bristol Sycamore helicopters have, on the advice of the manufacturers, grounded these aircraft pending the results of an inquiry into "a potential source of weakness in the shaft driving the tail rotor." Suitable modification should by now have been developed, and it is hoped to have all Sycamores flying again by the end of next week.

Private-owner Jets

PROGRESS with the two private light jet racers which are being developed for Fred Dunkerley and Nat Somers is all too slow for the prospective owners, but nevertheless steady. The Sparrowjet (or should it be Sparrow Twinjet?) which has, of course, already flown, is now having work done on its Turbomécas. The Somers-Kendall special should be recognizable as such when the several completed units are attached to the as yet embryonic fuselage. The latter aircraft is unlikely to be ready to participate in this year's races.

Reliable Air Supply

IN sending us a fascimile of the letter from the Aero Club de France confirming the F.A.I.'s acceptance of the SNCASO Djinn helicopter's world altitude record (see p. 107, *Flight*, January 22nd), the Turboméca company enclose details of a recent endurance test completed by the Djinn's power unit. This is the Palouste gas-turbine/compressor set, which supplies air to non-burning jets at the tips of the rotor blades. It completed a total of 1,000 hours' continuous running, made up of ten test cycles, each of which consisted of four hours at 200 h.p. air delivery, followed by three hours at 150 h.p., two hours at 100 h.p. and one hour at 50 h.p. Some notes on the Palouste will be found on page 159.

AIR CHIEF MARSHAL SIR JOHN BAKER, Controller of Aircraft, M.o.S., recently visited the factories of the Gloster Aircraft Co., Ltd., and the Brockworth Engineering Co., Ltd. Gloster executives with him in this group are: (Back row) E. S. Greenwood, sales manager; E. W. Shambrook, director and secretary; H. Burroughes, director. (Front row) R. Walker, chief designer; P. G. Crabbe, managing director; and "Bill" Waterton, chief test pilot.

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The fitting of hydraulic servo-controls—a unique feature of the Westland S51 and S55 Helicopters—has removed much of the tedium of pilotage. Coupled with the all-metal blade system, they are but typical of the technical advances introduced by Westlands in the S51 and S55 Helicopters which now have well over half a million operational hours to their credit.

WESTLAND S·51 & S·55 HELICOPTERS

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AIRCRAFT INTELLIGENCE

TWO MORE: On this page on January 8th we published photographs of the Cutlass and Skyray, two new transonic fighters for the U.S. Navy. Here are two others in the same category: the McDonnell F3H-1N, and the North American FJ-3 Fury. Unlike the Cutlass and Skyray, these aircraft have horizontal tail surfaces—of the all-flying variety—and are finished in midnight blue. Both are referred to below.

France

New Fighters. There is growing interest in the "canard" layout, in which conventional horizontal tail surfaces are replaced by an irreversible tailplane mounted at the front of the aircraft. Stability, maximum usable lift coefficient and manoeuvrability are all stated to be improved, and it is also possible to reduce the area of the wing. Dassault are working on these lines (see paragraph below) as are SNCAN and SFECMAS, whose successor to the Gerfaut (described last week) will be a canard.

Dassault Mystère XX. Recent announcements by Dassault state that the Mystère XX will have a "maximum horizontal speed of Mach 1.2." No authoritative details are given, but it is believed to be an intercepter variant powered by a late-model Avon, and with a sharply-swept thin wing. A prototype will fly this year. Dassault are thought to have abandoned their delta-wing Mystère development.

India

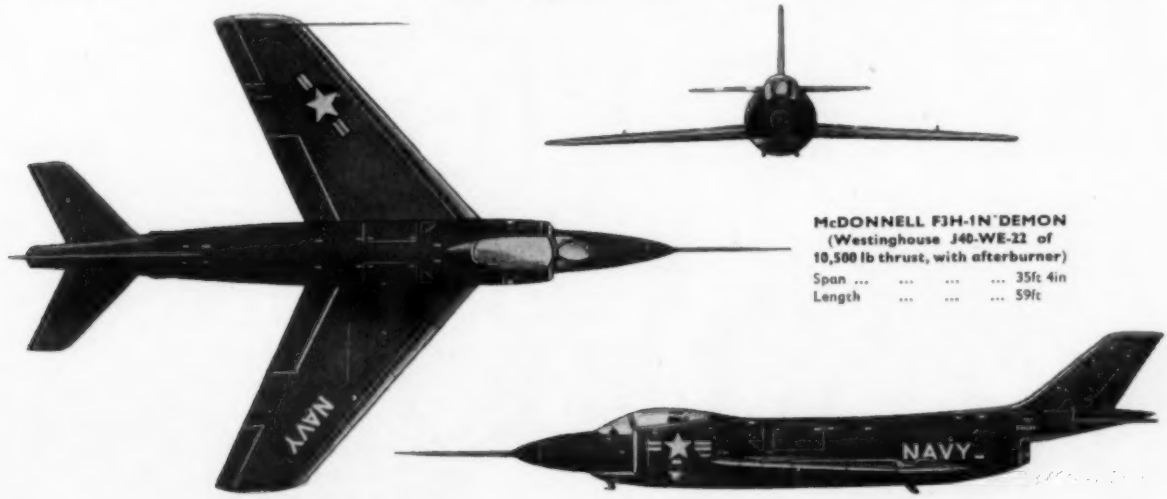
Military Equipment. New fighter and transport aircraft are now entering service with the I.A.F. The fighters are 71 French Dassault Ouragans, nearly all of which have now been issued to the I.A.F. for distribution to squadrons. The transports are Fairchild C-119Cs, ordered from the manufacturer through the U.S.A.F. It is stated that the Packets—26 of them—have not been bought with M.D.A.P. funds. Two have already been delivered.

United States

Bell XV-3. Signifying the adoption of "V" as a class-designation for convertiplanes, as distinct from helicopters ("H"), the Bell XV-3 is being developed at Fort Worth to an Air Force contract. It will have two or more rotors-cum-airscrews, which will be mounted on bearings so that they can be pivoted through 90 deg. The thrust line will be vertical for take-off and nearly horizontal in level flight.

McDonnell F3H-1N Demon. Subject of the drawing and a photograph on this page, the production Demon is now about to enter service with the U.S. Navy. Features of interest are the huge fuselage, housing over 700 gallons of fuel; the upswept "beaver-tail" rear fuselage, the engine intakes flanking the nose, and the weapons bay beneath the fuselage, housing four 20mm guns. Thirty-six R.P.s can be carried in addition, and it has been suggested that the Demon will be the most heavily armed carrier fighter in the world. The big J40 exhausts under the rear fuselage, and the small fairing can be seen covering the port linkage for the afterburner eyelids. Pressure heads can be seen under the nose and on the wing tip, while this machine also carries an angle-of-attack and yaw boom on the nose. The huge slats are fully open as are the inner flaps. The outer flaps are fitted between the fences above the trailing edge and the tiny ailerons. The Demon is smoothly transonic and promises to be effective. Although it is another of the Navy aircraft held up by development trouble with the J40 engine, later Demons will have the bigger Allison J71, of rather greater thrust.

North American FJ-3 Fury. Illustrated on this page is the Sapphire-powered carrier-based Sabre variant, which was discussed in our issue of January 15th. The photograph shows the ports for two of the four 20 mm guns, the revised undercarriage, with stronger legs and huge doors, the open slat on the folded swept wing, and the canopy which slides along a cranked track (early Sabres used a straight track, while later Sabres have clamshell hinged canopies). This version of the Fury is now in service, and is being replaced by the FJ-4, which has major aerodynamic and control changes.



McDONNELL F3H-1N DEMON
(Westinghouse J40-WE-22 of 10,500 lb thrust, with afterburner)

Span	...	...	...	35ft 4in
Length	...	...	...	59ft

PRESSURE REFUELLING

A Modern Method and its Advantages : The Components Described and Explained

By A. W. GOODLIFFE

THE Swift and Hunter will be the first fighters to go into squadron service equipped for pressure refuelling. The system permits time spent on the ground between operational sorties to be reduced to the minimum. Meteors refuel, by the gravity method, at an average rate of 50-60 gal/min; the Swifts and Hunters will be able to take fuel aboard at rates approaching 200 gal/min. This article, specially written for "Flight" by Mr. A. W. Goodliffe, chief designer to Flight Refuelling, Ltd., provides an appreciation of the subject. Flight Refuelling designed and produced the first aircraft refuelling valve sixteen years ago; it was used in a Harrow operated by Imperial Airways. Since then the company, headed by Sir Alan Cobham, has pioneered in the field of pressure refuelling and has designed and manufactured a range of components to meet present-day requirements.

SINCE it is now a mandatory requirement that modern aircraft (with certain exceptions amongst the lighter types) are to be pressure-fuelled, and as types incorporating this feature are in, or about to enter, squadron service in the Royal Air Force, this article has been written with a view to providing the reader with an overall picture of this up-to-date method of high-speed fuelling.

Before going into detail on an actual system, it is as well to know a little of the background which led to the final acceptance and introduction of this method; and, to those not yet acquainted with them, perhaps a reiteration of the advantages of this method will not be out of place.

The idea of pressure fuelling is by no means new. Although the fact may seem contrary to normal practice, its first practical application was made in the air, since it was apparent from the start of these experiments that, to fuel airborne aircraft from a tanker aircraft, the receiver fuel system must have a single filling-point through which its tanks could be filled with the minimum of delay and the maximum speed.

The problem of ground fuelling was not, of course, so urgent as the airborne case, but the old method of either gravity filling from cans or from tankers with indifferent rates of flow suffered from definite drawbacks. It was ponderous, untidy and entailed the unscrewing of filler caps and the manhandling of hoses against wing and fuselage surfaces. The advent of high-speed aircraft saw the swan-song of such methods, because it brought dangers to the forefront, quite apart from the fact that it was no longer desirable to cut holes in wing surfaces that had been designed to fall within the stringent limits laid down for such machines.

Even if the physical drawbacks of the old method could be glossed over, the rate of fuelling and, therefore, the time these aircraft were to spend on the ground, could certainly not be ignored. When it is considered that if a modern intruder with a fuel capacity of, say, 1,500 gal, fuelled by the old-type tanker with a rate of delivery of, at the best, 30 gal/min would take 50 minutes, a new method was obviously long overdue. This becomes even more apparent when an aircraft such as the Comet is considered, which requires something of the order of 6,000 gal of kerosine at one fuelling.

In such cases every hour unnecessarily spent on the ground is time lost, and may be the cause of increased operating costs. Any gain in the utilization factor, obtained by a more rapid fuelling, must therefore be of a very high significance. In actual fact, this very point has been well proved and the Comet now regularly fuels with 21 tons of fuel in 20 minutes. If the old method had been used, this period would have been very nearly seven hours.

It is stated above that pressure fuelling is now mandatory on almost all new aircraft. Because of this, certain requirements must be met; the essential points are:

(1) The pressure at the aircraft filling point or points must be 50 lb/sq in and the aircraft system must be able to accept fuel at a flow corresponding to this pressure without damage to the system or tanks. The system must also be designed so that it is not possible to produce a surge pressure in excess of 75 lb/sq in.

(2) The aircraft system must be so designed that it can be fuelled in the time laid down in the aircraft specification.

(3) There must be a means of fuel-level indication in addition to the fuel-contents gauges in the cockpit.

(4) The aircraft filling-point must be so positioned that fuelling is possible without having to gain access to the upper surface of the wings.

Since the rate of flow into the aircraft will vary with its capacity and the time laid down in which filling has to be achieved, no definite figures for this can be specified, but it is usual to think in terms of 150 gal/min for fighters and 300 gal/min for bombers or airliners. These figures are per filling point. The number of filling points is not mandatory, but it is normal for aircraft up to 1,500 gal capacity to have one point and above this capacity to have two; in the latter case, in the interests of economy, it is desirable that the whole aircraft may be filled from either of its points. It is of interest to note at this stage that a rate of flow

(1) Probe nozzle.
(2) Ground refuelling coupling, nose unit.
(3) Ground refuelling coupling, aircraft unit.
(4) Float switch.
(5) Collector box.
(6) Mk 12 refuelling valve.
(7) Mk 20 transfer valve.
(8) Pressure relief valve.
(9) Mk 17 filling valve.
(10) Non-return valve.
(11) Scavenge box.
(12) Engine pump.
(13) To nitrogen supply.
(14) To atmosphere during refuelling.
(15) To air pressure supply for fuel transfer.
(16) To atmosphere.
(17) Vent valve.

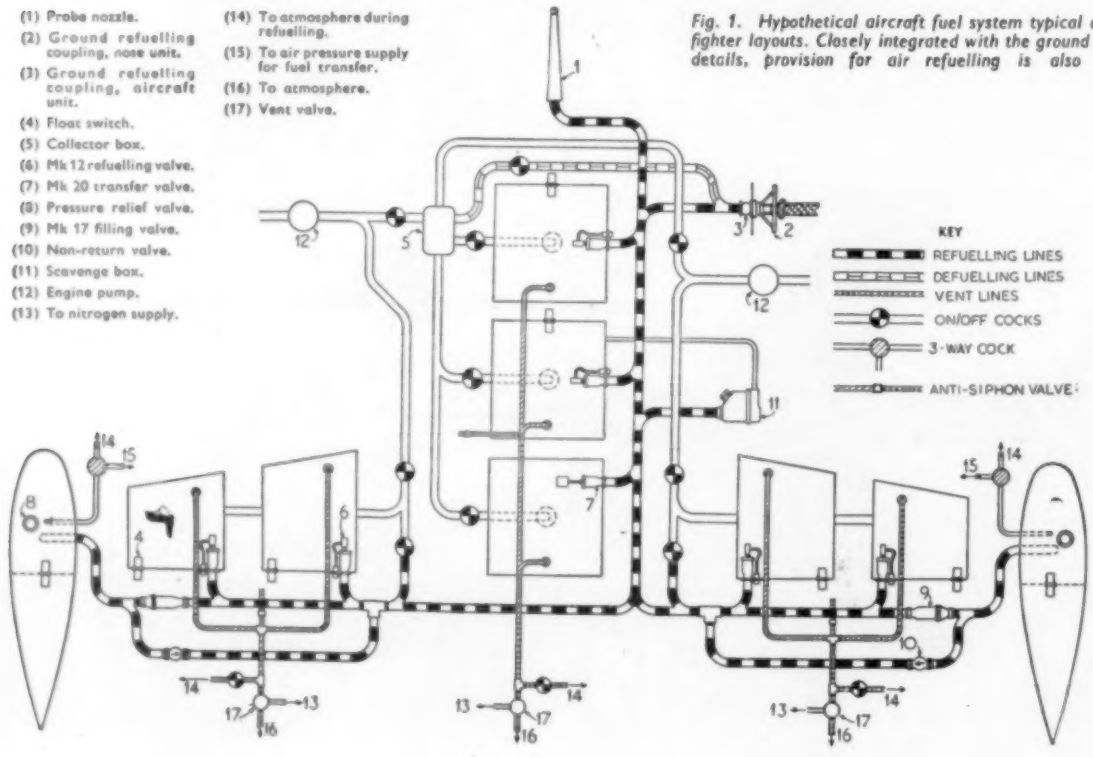


Fig. 1. Hypothetical aircraft fuel system typical of modern fighter layouts. Closely integrated with the ground refuelling details, provision for air refuelling is also included.

of 500 gal/min through one filling point was achieved on a multi-engine aircraft in 1951.

In addition to the mandatory requirement relating to the position of the filling point, it is recommended that the position of the point is such that it can be reached by an operator standing on the ground but would not receive damage in the event of the aircraft making a wheels-up landing. The importance of the operator being able to reach the filling point easily will be appreciated when it is realized that, to make the connection, a length of fuelling hose filled with fuel, plus the nozzle weight, must be manœuvred into position with the least possible delay.

Having briefly covered the background and discussed the requirements for a system, let us now take a hypothetical fuel system as illustrated in Fig. 1, on the opposite page, and follow it through to appreciate fully how the requirements and recommendations can be met. The system shown is typical of any modern layout; and, while this article is not concerned with air fuelling, it has been added in the system to demonstrate how closely allied is ground pressure-fuelling to air fuelling—the only difference is the actual location of the filling point. As the passage of the fuel is traced through a particular component, a brief outline of its function is given to assist the reader in understanding how the various problems have been overcome.

Before the fuelling operation can start, connection must be made from the tanker to the aircraft filling-point. The hose nozzle (Fig. 2) is designed to comply with the bayonet-attachment limits and "space envelope" agreed upon internationally and in accordance with the Ministry of Supply Instruction GM.12042.

Although various makes of such hose nozzles may vary in their functional details, the fact that they all comply with a definite specification ensures that they will fit the aircraft adapter on any machine; thus the case should never arise of an aircraft being grounded for lack of the correct tanker equipment. The nozzle illustrated incorporates a number of features which include a positive-action flow control with visual ON/OFF indication; and to facilitate connection by the operator, the method of sealing the nozzle is such that the loading on the seals is not imposed until after initial engagement has been made. An interlocking device on the valve mechanism positively ensures that in no circumstances can the operator disconnect the nozzle while fuel is flowing. Similarly, it is not possible to open the nozzle valve unless it is connected to an aircraft adapter.

The adapter to which the nozzle is applied is also manufactured to an internationally agreed specification, for the same reasons as apply to the hose nozzle. The bayonet socket is identical in dimensions for all makes and for both sizes, i.e., 1½in outlet for small aircraft and 2½in outlet for large types. This again ensures complete standardization of all the essential parts. Covers are supplied for fitment to these adapters and they are capable of withstanding an internal pressure of 75 lb/sq in and a suction of 15in mercury. This prevents any likelihood of any fuel leakage from, or any air leakage into, the filling points when they are not in actual use.

The ground tanker equipment for the supply of fuel to the aircraft is capable of a delivery pressure at the hose nozzle of 50 lb/sq in and is equipped with a pressure-sensing device which ensures that under no circumstances can this pressure be exceeded. Immediately the hose nozzle is opened, fuel begins to flow through the aircraft adapter into the main fuel gallery and into the fuselage, wing and tip tanks *via* the filling valves installed either in each tank or in the fuel line leading to a tank. The line to the air fuelling probe is pressurized at the same time as the main filling gallery, but no leakage to atmosphere can take place, since the probe valve acts as a non-return valve when pressure is applied to it in the reverse direction. The function of the filling valves is to allow fuel to continue entering the tank until a predetermined level is reached, at which point the valves will automatically shut-off either by direct float actuation or through the operation of a solenoid, thus preventing overflowing and excessive pressures in the tanks.

The two leading fuselage tanks have solenoid-actuated filling valves, a float switch (Fig. 3) being installed in each tank to make or break the solenoid circuit as the filling condition demands. This type of valve operates on the pressure-differential system (as, in fact, do all the filling valves shown in the system), which ensures that at the shut-off point there is a progressive closing of the valve and not a snap action. Any snap-action type of valve is to be avoided since it would give high surge pressures with resultant damage to the fuel lines. To guard against a surge pressure in excess of 75 lb/sq in, however, the valves incorporate relief mechanisms which operate below this figure and exhaust fuel from the lines into the tanks.

Under static conditions, i.e., when fuel is not flowing, the valve solenoid is de-energized and current is applied only to open the valve during the actual fuelling operation. Thus, in the event of an electrical failure the valve will automatically cut off the fuel

Fig. 2. The hose nozzle (above), locked by a bayonet joint to the aircraft coupling. (Below) Coupling with sealing cover removed.

supply and will remain in the "safe" condition until the fault is rectified. Since the current consumption of these valves is 0.3 amps at 24 volts, there is very little drain on the main aircraft supply.

As the fuel in each tank rises to the predetermined level, the float switch operates and cuts off the supply to the solenoid (Fig. 4). The valve then progressively closes and cuts off the supply of fuel into that tank. One of the advantages of using the solenoid type of valve is that it can be installed in any suitable position in the tank. In fact, it is always preferable that its position should be as low as possible so that the incoming fuel very quickly covers the valve inlet ports, since, when these ports are immersed, the tendency towards fuel frothing is eliminated and the operation of the float switch is made more positive.

The float switch in the diagram is merely representative of the many types available, but in nearly all cases the basic switch remains the same and it is the shape and type of the float arm only which varies. This type of switch is capable of making and breaking a current of 10 amp at 28 volts or 2 amp at 200 volts and is also able to carry a 7 amp inductive load. The mechanism of the switch is very simple and is therefore very reliable; it consists of a rocker arm, at one end of which is attached a permanent

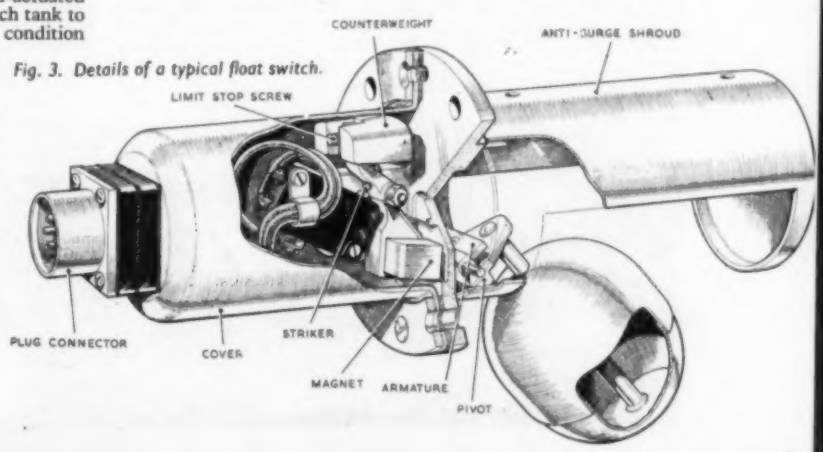
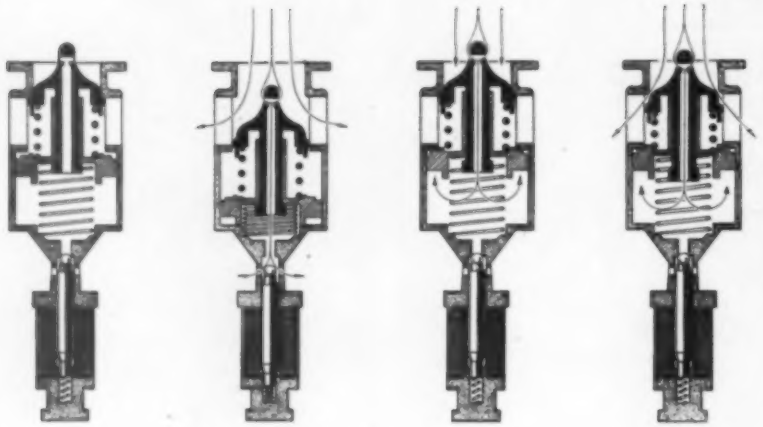


Fig. 3. Details of a typical float switch.



(1) **Static Condition.** Solenoid de-energized. Piston assembly held in closed position by return spring.

(2) **Flow.** Solenoid energized. Plunger and ball pulled away from seat. Piston assembly moves downwards and fuel flows through the body outlet ports and through the piston assembly and out of the solenoid throat ports.

(3) **Shut-off.** Solenoid de-energized. Solenoid spring forces plunger and ball back on to its seat and the lower chamber of the valve is sealed. Pressure built up on underside of piston assembly. Since pressure on piston crown is equal to pressure on underside of piston body, and because the underside piston area is greater than crown area, piston assembly moves upwards and closes the valve.

(4) **Relief.** If inlet pressure rises above shut-off pressure, piston crown is depressed against relief-springs while piston body remains in fully closed position.

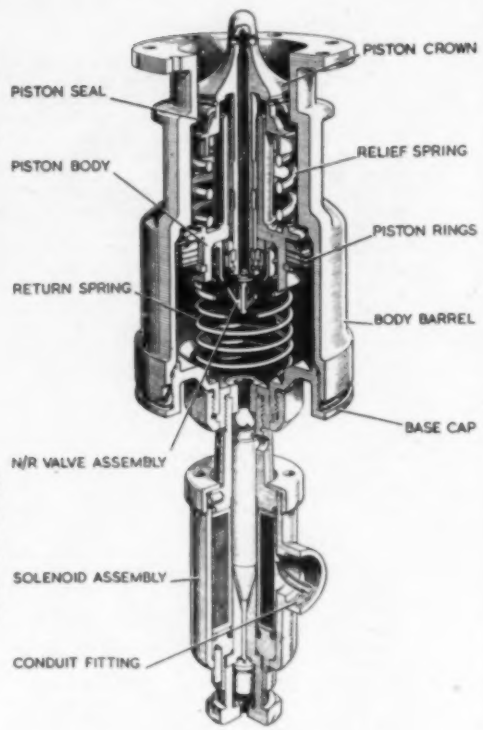


Fig. 4. On the right, shown in sectioned form, is a solenoid valve of the type supplied for the Comet. The series of diagrams on the left shows the sequence of operations in a typical solenoid valve.

PRESSURE REFUELLING . . .

magnet. As the float arm rises or falls, an armature attached to the float arm attracts or repels, through a diaphragm, the magnet on the rocker arm. Movement of the rocker actuates a small switch which makes or breaks the electrical circuit.

Fuel passes into the rear fuselage tank through a float-operated filling valve which can also function as a transfer valve. The principle on which this valve operates is identical with the solenoid-operated valves in the forward tanks, but in this instance the float and float arm directly operate the valve and therefore no float switch is required. At this stage the question may be raised as to why solenoid-operated valves should be used in the forward tanks, instead of the less complicated float valve. The answer is, of course, that with an electrical valve, provided a manual switch is placed in the circuit, selective fuelling can be achieved, thus varying the fuel load to meet different aircraft load/range cases. The use of the float-operated valve as a transfer valve is discussed later.

The manner in which the wing tanks are fuelled is identical with that applying to the two forward fuselage tanks, i.e., through solenoid-operated valves and float switches, and the fuel gallery which carries fuel to the wing tanks is extended on each wing into the tip tanks. It would obviously not be practical from the viewpoint of economy to install a filling valve in these tanks, since they may be jettisoned, and a line-mounted valve is therefore positioned between the outer wing tank and tip tank. This again is a solenoid-operated pressure-differential type of valve controlled by a float switch installed in the tip tank.

The in-line type of valve is of particular interest and is a comparatively recent development. A valve of this kind is extremely easy to install and offers enormous advantages from the maintenance viewpoint, since it is no longer necessary to remove a tank or to disconnect tank fittings when valve servicing becomes necessary. The photograph (Fig. 5) shows show simple the installation really can be. No relief mechanism is incorporated in the valve because of the low rate of fuel flow which it handles. Later types of this valve, which are designed for higher rates of flow, incorporate such a mechanism as well as a provision for defuelling.

It will be noticed that each tip tank is fitted with a separate relief valve to protect the tank in the event of a failure of the filling valve. This relief valve (Fig. 6) has interesting features made necessary through its particular application in the wing tip tanks which are normally designed to withstand a comparatively low pressure because of the desire to keep their weight to a minimum. If, for example, the maximum permissible pressure in such a tank is 12 lb/sq in and it is desired to use a valve "cracking" pressure of 7½ lb/sq in, the permissible tank pressure would be exceeded before any reasonable flow could pass through the open valve and thus relieve the internal pressure. The characteristics of the valve illustrated overcome this problem by "cracking" at 7½ lb/sq in and remaining in the fully open position until the internal pressure drops to 3 lb/sq in. While open, the valve is capable of passing up to 65 gal/min, without exceeding the 7½ lb/sq in "cracking" pressure.

From the fuel system diagram it will be seen that there is a by-pass fuel line from outboard of the in-line valve to inboard of the inner wing tanks, a non-return valve being inserted in this line. This line is used during fuel transfer from the tip tanks to the rear fuselage tank and, if a non-return valve were not inserted, the tip tanks would fill direct and not through the in-line valve; this would, of course, produce disastrous results.

Fuel transfer is accomplished by applying an air pressure to the tip tanks from the engine compressor and forcing the fuel through the by-pass lines and non-return valves into the main gallery and into the rear fuselage tank *via* the float-operated filling valve. For this hypothetical case, and remembering the tip-tank relief valves are set at 7½ lb/sq in, let us assume that this transfer pressure is 6 lb/sq in. At this pressure the valve will open sufficiently to allow transfer to take place. During transfer the solenoid-operated valves will remain closed, since no current is being fed to the solenoids.

Fig. 5. Compact and simple installation of in-line type of valve.

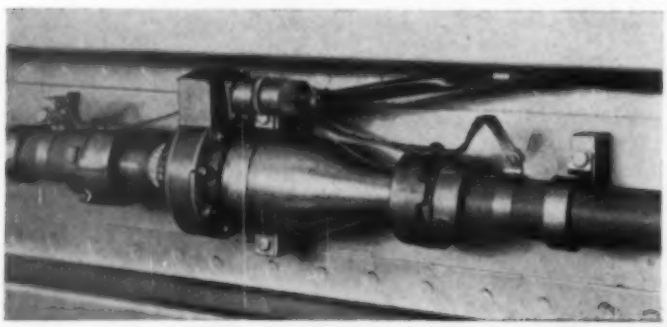


Fig. 6. Pressure relief valve as fitted to tip tanks.

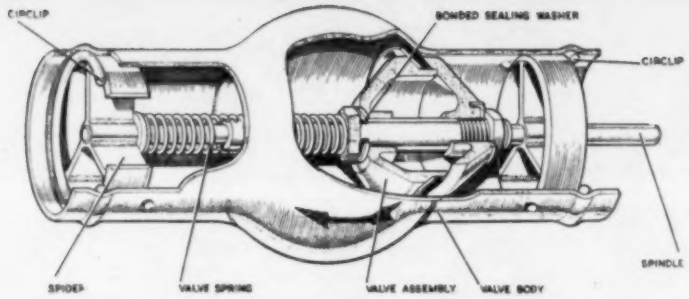
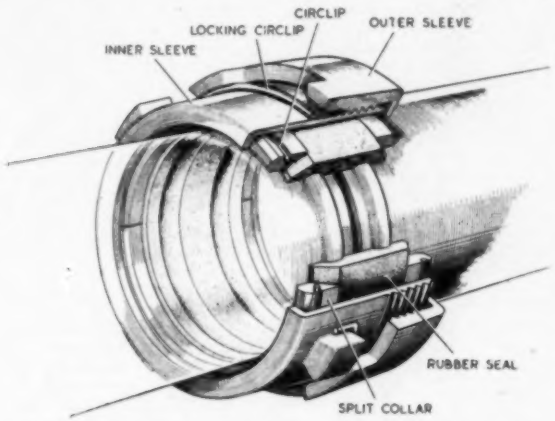


Fig. 7 (above). Simple internal mechanism of a non-return valve.
Fig. 8 (right). Face of "tanks full" indicator, the warning lamps of which are extinguished as the various filling valves close.
Fig. 9 (below). The modern type of pipe connector, which, able to handle high pressures, is replacing the familiar link made of fuel-resistant hose.



Before leaving the transfer system, a word or two about the non-return valves will not be out of place. Although Fig. 1 shows two non-return valves only, these components have a very wide general use in fuel systems and there are many types available. While their mechanism is so simple as not to warrant any description, it is interesting that the type shown (Fig. 7) apart from being line-mounted, is extremely light, with a very low pressure-loss; e.g., a 1¼in valve which weighs 4¼ oz shows a pressure-loss of 4½ lb/sq in at 80 gal/min. A further important feature is that, unlike many other types of non-return valve, they are positively leakproof from 0.1in water gauge to 100 lb/sq in.

So far no mention has been made of the venting system, but it would be erroneous to think that it plays only a small part in fuel system design. The basic need for an adequate venting system is to provide a means of escape for the air displaced in each tank as the fuel level increases, and to provide an inlet or outlet for air as the aircraft altitude changes. This latter point is of tremendous importance today for some military aircraft can climb at rates exceeding 15,000ft/min.

During ground fuelling it is essential that the vent in each tank can pass to atmosphere the full quantity of fuel entering that tank, so that damage is prevented in the event of a failure of the normal shut-off device. Should such failure occur, the inertia of the fuel leaving the tank after the tanker supply has been cut off may create an internal depression of such magnitude as to cause a tank collapse. There is more likelihood of this occurring where the flexible type tank is used. To eliminate the possibility of such collapse, anti-siphon valves are placed in all vent lines.

Because of the danger of boiling of the fuel in aircraft which operate at high altitudes, it is necessary to pressurize the tanks, and for this purpose nitrogen is used in preference to air, since there is less risk of fire in the event of a bullet strike during combat or a forced landing. The vents obviously cannot be in use when the tank is pressurized and these lines are used for the introduction of the nitrogen, the change-over being effected by the positioning of suitable cocks in the vent outlets. The control of these cocks must be automatic so that there is no possibility of ground fuelling being commenced with the vents closed, and their operation is usually carried out electrically, being controlled by a master fuelling switch positioned in the cockpit, or at the fuelling point.

It will be seen from the fuel system diagram that a scavenge box is incorporated. As its name implies, it is used to scavenge the fuel lines after the fuelling operation is completed. In fighter systems there is little need for such scavenging, since the amount of fuel remaining in the lines does not warrant the addition of the extra equipment. In larger types, however, this residual fuel can represent a considerable number of gallons which would be so much dead weight, and as such are certainly worth recovering.

The scavenge box is fitted at the lowest point of the system and is gravity fed. A small pump interconnected with a float switch is installed in the container and, as the fuel level in the container rises, the pump is switched on and the residual fuel is forced into the centre fuselage tank. This process continues until the fuelling gallery is emptied and the float switch switches off the fuel pump.

Although not shown in Fig. 1, it is now a definite requirement that a method of indicating "tanks full" is included in the system other than by the normal fuel-contents gauges in the cockpit. This is achieved where solenoid-operated valves are used in conjunction with float switches by fitting a small indicator (Fig 8) adjacent to the ground fuelling point; this indicator is inter-connected with the valve and float switch. The wiring is so arranged that, when a master switch energizes all shut-off valves for fuelling, the indicator lamps are illuminated. This serves as an electrical check of the complete installation prior to fuelling; and, as fuelling is completed and the filling valves close, the warning lamps will be extinguished. Any lamp not extinguished will indicate a failure, and the tank in which the failure has occurred. Where float-operated shut-off valves are used it is, of course, necessary to introduce a float switch or pressure switch in that particular tank. Interconnected with this electrical system and master switch are the vent and pressurization cocks to which previous reference has already been made.

The preceding paragraphs have followed the system through from filling point to tanks and have shown the method of application of the various fuel shut-off and safety devices employed, but so far no mention has been made of the method of connecting one pipe to another in the system. This may appear to be a very simple matter, but when the fuelling pressures are considered together with the need to keep the pressure-loss to a minimum, it must be realized that to find a suitable pipe connector that will comply with all the requirements was not easy. In the past it was usual to make pipe joints with a length of fuel-resistant hose secured by a number of hose clips. Today, with increased pressures, this method is both useless and dangerous. The connector illustrated has no captive end fittings, is light in weight and offers a degree of flexibility both axially and radially. These features make it simple to install, particularly where access is very limited. From the weight viewpoint it compares very favourably with the old type of connection; for example, a 1½in connector weighs 5 oz. Variants of this type of connector are made in the form of bulkhead and termination connectors which have the same advantages as the standard type. Heat shields are also available to shroud these connectors and to improve their fire resistance.

The emphasis so far has been on fuelling the aircraft, but it is just as essential to be able to defuel with the minimum delay. While it is a requirement that defuelling must be possible, the rate at which it should be carried out is left to the individual designer. The system illustrated is defuelled by the use of an engine pump which draws the fuel from the port wing tanks direct and from the starboard tanks and fuselage tanks *via* a collector box. No provision for defuelling the tip tanks is made since it is assumed that the contents of these tanks have already been transferred to the rear fuselage-tank. To avoid the addition of extra piping it is desirable that in future fuel systems the defuelling should be made through the fuelling gallery; but if this is done then the filling valves must also incorporate provision for defuelling. As mentioned earlier the later types of in-line valves are fitted with the necessary mechanism.

It is hoped from the facts given in this short article that the reader will have gained some idea of the modern method of fuelling aircraft and the type of equipment that is employed in such a system. Naturally, the story does not end here and with the new development of fuelling equipment which is going ahead all the time, it should not be long before filling rates of 1,000 gal/min will be commonplace. It has taken a long time for pressure fuelling to be accepted; but, now that it is in practice, it is obvious to all that any weight penalty incurred by the addition of extra equipment is by far outweighed by the advantages gained, and that the time is coming when the problem of aircraft turnround time both from the military and civil viewpoints will cease to be the bogey of the aircraft operator so far as fuelling is concerned.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Reserve Schools—the End

SO the final phase has arrived and the last seven Reserve Flying Schools are to be disbanded, thus bringing to a close nearly two decades of unstinted effort by the civilian operators and finally throwing to the four winds the vast accumulation of knowledge of flying training, knowledge second to none, which has been acquired during this time.

To one who for the six war years was part of the pattern it is a sobering thought that this should come about and also that the tremendous enthusiasm shown in the past should be finally rewarded by the loss of the only career that a large number of those most concerned know.

And what of the surplus Chipmunk aircraft? Will they be made available to the flying clubs at a price which these struggling organizations can pay? Always assuming, of course, that there are some clubs left after the departure of the unit which, in a large number of cases, was the main reason for the continued existence of a particular airfield.

However, be that as it may, the main hope must be that those instructors, navigators, control officers, engineers and ground staffs who will shortly be out of work, together with those who were similarly dismissed last year will find, in the near future, a *safe* job.

At the moment they all deserve the nation's sympathy, thanks and best wishes.

Thornton Heath, Surrey. C. NEPEAN BISHOP.

The Sopwith Pup

I WAS very interested in the excellent article in *Flight* January 1st by Mr. J. M. Bruce and the correspondence in the January 22nd issue, particularly concerning the little 50 h.p. "Hawker's Runabout." I saw this aeroplane at Hendon in October 1915; Hawker brought it over from Brooklands to show it to two Sopwith apprentices then undergoing flying training at the Hall School. I also saw the Sopwith known to your correspondent Mr. J. H. Williams as the "Sigrist Bus." Hawker took it up to 18,000 ft at Hendon in June 1915, a British altitude record. Mr. Williams mentioned the 1½-Strutter-like centre-section struts. The top plane was of very slightly greater span and the interplane struts were slightly raked to match. The engine (80 h.p. Gnôme) mounting and cowling were similar to those of the Sopwith Tabloid "bull-nose" and there were head fairings in front of, between, and behind, the cockpits. But its most unusual feature was a single centre skid under the airscrew, and I was told later that this skid contained several pounds of lead, to correct the c.g. position. Can anyone find a photograph?

London, S.W.7. E. J. ARNSBY.

REGARDING Mr. Taylor's remarks (January 22nd) on the Pup prototype, I would like to mention that the machine was not flown while in my possession, although used for taxying. It was flown later by the person to whom I sold it, after he fitted an 80-h.p. Le Rhône engine and ailerons. The name *Flycatcher* was not original but added by me; this could be misleading from the historical point of view. The Gnôme engine is, I believe, in the Shuttleworth Collection, having been purchased by the late R. O. Shuttleworth about 1936.

Billericay, Essex. R. C. SHELLEY.

THE letters about the Sopwith Pup (*Flight*, January 22nd) have contributed much valuable additional information about the aeroplane and its antecedents.

I was aware of the existence in 1925 of Mr. Shelley's little Sopwith biplane, but refrained from mentioning the fact because of a purely personal doubt that it might not have been Hawker's Runabout. I have long thought that the remarkably close resemblance borne by Mr. Shelley's machine to the Sopwith Sparrow was more than coincidental.

Whilst recognizing the equal probability of the Sparrow's development from the Runabout, I felt that no historian writing with any pretence to accuracy could afford to overlook the possibility that Mr. Shelley's machine *might* have been a Sparrow modified to take a 50 h.p. Gnôme in place of its normal A.B.C. Gnat. Any comparison of similar views of the Sparrow and *Flycatcher* will show the striking similarity of the two machines, a similarity which is not confined to general appearance, but extends to a surprising number of details.

Mr. Taylor's informative and authentic letter seems to dispel these doubts of mine, but I am now intrigued by the mystic type designation SL.T.B.P.

As for the Bee, Mr. Taylor may well be correct in asserting that the engine was an 80 h.p. Gnôme, which was externally well-nigh indistinguishable from the 50 h.p. engine of the same make. I must point out, however, that it would be no more illogical for the Bee to have had the 50 h.p. Gnôme than the 80 h.p. Gnôme, for the engine of the standard production Pup was the 80 h.p. Le Rhône, and a new installation would be required anyway. Some sources have in fact stated that the Bee had an 80 h.p. Le Rhône, but a photograph in my possession shows the Bee with a seven-cylinder rotary engine which has a single push-rod in front of each cylinder and no induction pipes visible from the front, as they were on the Le Rhône. The engine is clearly a Gnôme of either 50 or 80 h.p., and there is no connection with the standard engine of the Pup.

Mr. Taylor's mention of the installation of a Vickers gun on the Bee is interesting, for the machine would then be in much the same class as the P.V.7 and P.V.8; but such an aeroplane with warping wings would be rather a poor proposition so late in the war, even if taken seriously. The nearest parallel I can think of offhand was the little Austrian single-seat scout designed by Professor Knoller and built in 1917 by the Austrian Aviatik concern. Its warping wings were subsequently replaced by ailerons.

I agree with Mr. Cooksley that photographs, particularly of the machine in squadron service, are curiously scarce. One hears so much about the Pup being the last British Service aeroplane to bear pilots' individual markings, and about the gay and gorgeous nature of some of these markings; yet photographic evidence of their existence does not seem to have survived.

A point which must be corrected in the article itself is the printer's error which has occurred in the table of dimensions: the gap of the Le Rhône Pup was 4ft 4⅞in, the same as that of the Mono Pup. To the serial numbers should be added 3691 (the first prototype), and N.6160-N.6209; and collectors may like to know that N.6480-N.6529 were also allotted for Pups, but the contract was cancelled.

The letter from Mr. J. H. Williams is full of interest, especially his mention of the "Sigrist Bus." I wonder if any photographs of it are still in existence?

Birmingham 32. J. M. BRUCE.

Instrument Presentation

IN reply to the letter by W/C. P. H. Baldwin (January 23rd), I would like to point out that each vertical scale is identified by a letter or symbol above and/or below each scale. These might be larger and thicker than those shown in the illustration and would certainly be less confusing than existing forms of presentation.

With regard to altimeter indications, Veeder figures alone, without any scales or pointers, have great merit (see Grether, 1947). Their vital drawback—unreadability during extreme rates of ascent or descent—may be overcome in further tests by light-intensity coding and by considering the rate-of-climb indicator as an integral part of the altimeter.

Let us put aside preconceptions, traditions and experience, let us stop treating this subject on the same plane as automobile and Parisian dress design; instead, let us get down to scientific comparative tests of all feasible forms of presenting information.

While considerable funds are made available in the United States to finance the valuable work by Fitts, Gerathewohl, Grether, Jones, Milton and others, practically no funds for such work are available in this country. This lack of funds is very difficult to understand, as the fruits of this research might drastically reduce the number of air collisions, which must cost the R.A.F. about half a million pounds each year. Furthermore, the costs of a programme of comparative tests on different forms of instrument indications and presentation are relatively low as true working instruments are not required, manipulated mock-ups being quite sufficient.

London, W.2. O. W. NEUMARK.

Preserving Historic Aircraft

CONGRATULATIONS to Mr. Graeme Weir on his excellent article (January 22nd) concerning the preservation of our historic aircraft.

I, for one, sincerely hope that his scheme will be put into practice, and will gladly make my contribution to such a worthy fund—as will, I'm sure, many more who at some time had cause to regard these grand old aircraft with the utmost affection.

Cambridge. D. BILTON.

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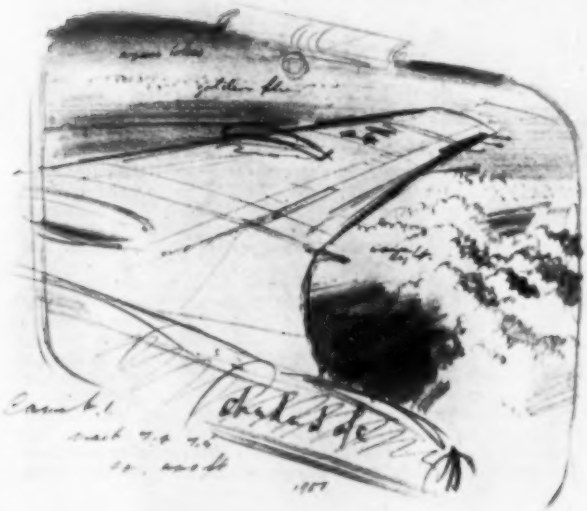
The Dove aircraft is fitted with

DE HAVILLAND PROPELLERS

Pilots under training—a page from the artist's sketchbook.

Wootton at work, Burma, 1945.

Colour notes from a Comet at 40,000ft.



Aeronautical Artist

SOME REFLECTIONS ON THE WORK OF FRANK WOOTTON

By ROBERT J. BLACKBURN

SINCE the world of flight is one of great visual beauty, it is in some ways surprising that so few modern artists have chosen aviation as their subject. It is fortunate, particularly from the historical viewpoint, that cameras have recorded a major part of aviation's first half-century. But although photography has taken over a great deal of the traditional work of the artist, it cannot do so completely.

Admittedly, the cameraman can do far more than record the outward semblance of machines and men. An air-to-air photograph of, say, an aeroplane performing an aerobatic manœuvre can give a great deal of satisfaction, particularly if the beholder has some conception of the sensations which accompany the evolution. Nevertheless, the camera recalls a scene dispassionately at one instant in time, whereas the artist preserves an atmosphere in an essentially human way. He can appeal to the emotions with an exaggeration of line, form or colour; and into one canvas he can concentrate all the relevant experience of a minute or a lifetime.

Although the lens is quicker and usually more accurate than the brush, there are still times when the human eye and hand can produce far more rewarding results. For example, some of the most dramatic aeronautical scenes are found at night or in bad weather, when all the photographer can offer is a clash of chalky white and sooty black or a flat impression of uniform greyness.

It is unquestionable that the majority of artists have little love of things mechanical; and that many are allergic to aviation, which they regard as an overwhelmingly new and rather repellent compound of smells, noises and mechanical sickness. But a few, who have responded to the compelling appeal of the airman's world and of the machines he uses, have found an artistic home in this new world.

Among them, I believe, the one who most completely personifies the qualities required of the aeronautical artist is Frank Wootton.

His ability to draw aeroplanes accurately is not unique, but there is a great deal more besides. Wootton's pictures are æsthetically pleasing not only as portraits of well-designed

R.A.F.V.R. Chipmunks are the subject of the lively water-colour above.

A typical "Wootton" is this impression, in oils, of a Vampire at exercise.

(Left) Mustangs in a Normandy pasture, 1944; finished oil-painting, and above it, the charcoal rough.

Aeronautical Artist . . .

machines at their best but because they reflect from a new aspect some of the infinitely varying patterns formed by land, sea and sky.

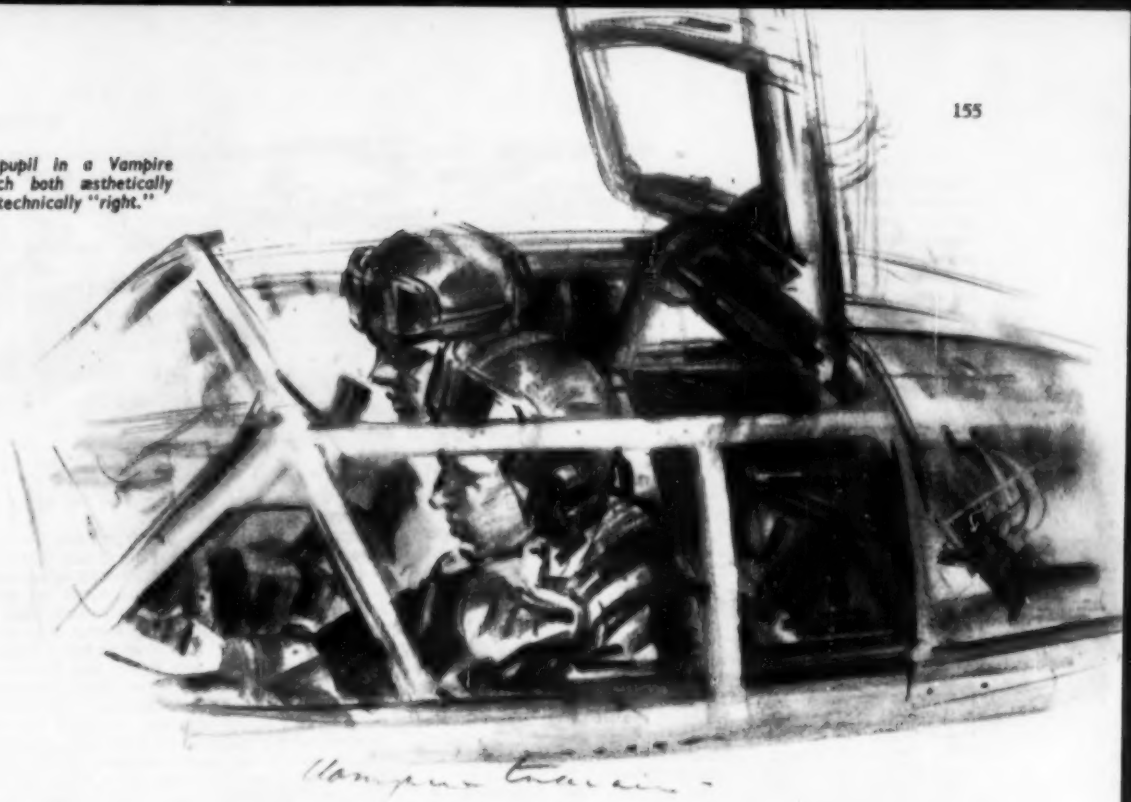
Today's artists are not always expected to record or even represent broadly the physical appearance of their subjects; in this sense Wootton might be regarded as old-fashioned and unimaginative. In fact, a controlled sense of composition and a deft brush are, to an aeronautical artist, greater assets than an over-developed sense of design. By reason of its supremely functional shape an aeroplane can be a thing of overwhelming beauty; an inaccurately drawn representation gives little satisfaction, even to the eye of the non-expert, because it destroys some part of the original design.

As might be expected, it was Frank Wootton's schoolboy hobby to draw aeroplanes. He continued to do so as a student at the Eastbourne School of Art, not always with the approval of his teachers. The district was not rich in aeronautical inspiration, the only nearby aerodromes being at the R.A.F. station at Hawkinge and the now defunct civil field at Wilmington.

Hawkinge provided Wootton with material for his first serious aircraft painting—an impression in oils of three Furies in a dive. This picture, which he showed to me with reluctance and quite needless apologies, would have been a credit to an experienced painter. It showed already a masterly skill in depicting the play of light on metal surfaces; this he appears to do more effectively and with less apparent effort than any of his contemporaries.

Shortly before the war, when working in a London commercial studio, he showed some of his aircraft drawings to de Havillands. The company liked them and commissioned a number of paintings, the first of which portrayed the then-new Moth Minor. Commercial patronage of this kind soon enabled him to set up as a freelance specializing in aeronautical subjects. Now 42, he has unquestionably reached the pinnacle of his chosen profession.

In 1940 he volunteered for services in the R.A.F., but, instead, was chosen to tour fighter stations as a civilian artist. The result was a series of portraits of pilots and narrative paintings of incidents in the Battle of Britain, many of which now hang



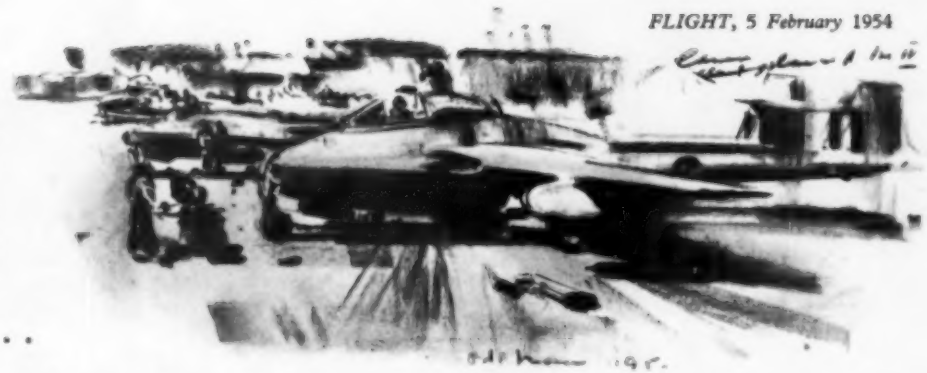
Instructor and pupil in a Vampire Trainer—a sketch both æsthetically satisfying and technically "right."

in R.A.F. messes. The pick of this crop was perhaps the famous plan view of three Spitfires against a delicate mackerel sky; the original painting was destroyed in an air raid on Fighter Command H.Q. at Stanmore, but there is a fine reproduction in the Royal Aero Club.

Following Wootton's eventual acceptance for the R.A.F., in 1942, he enlisted in the improbable trade of instrument repairer. In the event, he was employed for the next two years as a draughtsman, working on posters and instructional drawings of bomb-sights, gun turrets and like equipment.

In 1944 he was summoned before Air Marshal Sir Trafford Leigh-Mallory, Commander of the Allied Expeditionary Air Force. Sir Trafford, it transpired, had been presented with some "Woottons" and had decided that their creator was the best man to record on canvas the progress of the air armada then massing for the Normandy invasion. So Wootton went to France in the uniform of a war artist for a hectic but very productive six months. Then came a further invitation from Sir Trafford, who suggested that the artist should accompany him to India and Burma for the final stages of the air war against Japan. But

Dakotas on a Burma airstrip, painted on the spot with characteristic speed and precision.



These two studies of Vampires at dispersal provide a revealing glimpse into Wootton's technique. Seemingly quick and casual, the working drawing in fact provides the artist with all he requires to complete the painting; even what appears to be little more than a smudge of charcoal plays its part in building-up the final composition.

Aeronautical Artist . . .

for the fact that Wootton had work to finish in Belgium, he might have been aboard the York which, in November 1944, carried the C-in-C. and his wife, staff and crew to their deaths in the French Alps. The artist flew out to S.E.A.C. shortly afterwards, and there made some vivid pictures of the men and aircraft—particularly Spitfires, Thunderbolts, Mosquitoes, Dakotas and Liberators—engaged in a struggle whose hardships had not always been fully appreciated at home.

Many of Wootton's best pictures were painted during his period as a war artist, and it is unfortunate that there is no museum in this country where work of this type can be displayed for the aviation community in particular. I believe that only one of his paintings is shown in the Imperial War Museum—a striking impression of the destruction wrought by rocket-firing Typhoons among German armoured columns during the battle of the Falaise Gap in August 1944.

Painted on the spot—it could not have been otherwise—the Falaise picture is regarded by the artist as his most exacting work. It took him two weeks to complete, and the size of the canvas—about 5ft × 4ft—must have made it an embarrassment in the battle area. The result is a picture which remains in the memory. The scene is a bend in a country road, the hedgerows strewn with smashed German armour; the sky is darkened by smoke and dust, and pale light glints on the Typhoons storming overhead in search of further targets. The improvised airstrips which he painted at this time reflect this same contrast between sunny pastures and the out-of-place instruments of aerial warfare. The picture reproduced on the left of page 154 exemplifies this theme.

Painting under battle conditions was not without its difficulties. In India and Burma, Wootton found that aviation petrol solved the problem of thinning his colours when turpentine and linseed oil were unobtainable. This method not only produced a satisfactory effect, but the paint dried more quickly; the idea proved equally useful during a post-war visit to Iran on behalf of an oil company. His most anxious moments were when the Anson in which he was flying was fired at and hit by British Naval guns; but the aircraft ditched safely near Selsey Bill.

After the war Wootton resumed his freelance work. Aviation remains his major interest, although he draws cars and locomotives with great skill. Landscapes, notably restful impressions of the undulating, pastel-coloured South Downs, are his relaxation, and three of these have been exhibited at the Royal Academy since the war. The artist's studio is picturesquely situated in the garden of the 300-years-old Sussex cottage where he lives with his wife and two children.

Oils are his favourite medium. He prefers to work from the actual subject rather than from photographs and sketches, and he likes to complete a painting in a morning or an afternoon. The speed and confidence with which he paints are largely responsible for the unmistakable character of his work. Too many pictures of aircraft seem to consist of a carefully drawn outline filled-in with colour and awkwardly superimposed on a background of land or sky; but Wootton's aeroplanes always blend with their surroundings without sacrificing accuracy of line.

His technique is not wholly consistent, and generalized criticism is therefore difficult. Perhaps one would be justified in complaining that his composition—though certainly not his brushwork—occasionally tends to produce a photographic effect. I should like to see him experiment a little more with perspective and shadow. It is also true that much of his work is "commercial," but this is a hard fact and not a criticism. Without commercial sponsorship there would be no such artists as Wootton—or if there were, very few people would be able to enjoy their pictures.

This almost-photographic impression of a Constellation over Sydney Harbour was painted for a B.O.A.C. calendar.

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HELICOPTER FORUM

A Useful Thrashing-out of Problems at Helicopter Association's Brains Trust

FROM time to time the Helicopter Association of Great Britain organizes a Brains Trust, during which both written and oral questions are discussed and answered by a team of experts. On January 22nd, when another of these gatherings took place at Londonderry House, the panel consisted of Mr. L. G. Frise, technical director and chief engineer of Percival Aircraft, Ltd.; Dr. G. S. Hislop, chief designer, helicopters, of the Fairey Aviation Co., Ltd.; Mr. K. Reed, chief helicopter test pilot of Saunders-Roe, Ltd.; Mr. J. Shapiro, aviation consultant and previously chief technical officer of the Cierva Autogiro Co.; and Mr. R. H. Whitby, performance and analysis manager of B.E.A. Mr. Raoul Hafner was prevented at the last moment from attending, and his place was taken at short notice by Dr. Hislop. The Editor of *Flight* was Question Master on this occasion.

The team were introduced by Mr. Norman Hill, chairman of the Helicopter Association, and the Question Master then explained the method by which a committee had used a marks basis to select the questions from the many submitted in advance. The selection committee did not know the identities of those who sent in questions.

The questions are set out below, together with—in abridged form—the answers. A printed report removes the need for summing-up; the Question Master's remarks have therefore been omitted.

What is the maximum speed likely to be achieved by helicopters in the foreseeable future, and what are the limiting design or other factors?

MR. WHITBY thought that the limiting design and other factors were, in his view—though this was not shared in all quarters—the stalling of the retreating blade and compressibility effects on the advancing blade. There were various ways of overcoming this—by limiting the speed of the rotor to minimize compressibility effects, or by reducing the working lift coefficient on the retreating blade, which could be done by putting up blade chord or, on the other hand, making the rotor turn faster. If one employed these methods, more power was absorbed by the rotor to do a given amount of work, so that was a practical limitation. Practicable speeds for pure helicopters, thought Mr. Whitby, would be in the region of 150 m.p.h. An alternative way of reducing the lift on the rotor and reducing the tendency to stall was to unload the rotor by putting some lift into fixed wings—almost turning the helicopter into a fixed-wing machine in forward flight. In the foreseeable future one might then have speeds of the order of 200 m.p.h.

DR. HISLOP agreed with Mr. Whitby's suggestions. Speculating upon what in turn would be the limiting conditions when there was a fixed wing to unload the rotor, he thought there were definite stability problems when the rotor became very lightly loaded—an Autogiro, in fact, taking perhaps a tenth of the aircraft weight, or even less. With this lighter disc, one was then likely to be in severe stability troubles. He would have thought that by careful choice of the parameters Mr. Whitby's estimate of 200 m.p.h. might be exceeded by just a little. So far as pure helicopters were concerned he was substantially correct.

MR. REED said that if we were approaching the maximum speeds being obtained with present helicopters, there were vibrational problems. True, we were given to understand that they were more or less directly concerned with the rotor system and the tip of the blades; but were we going to assume that those blades—from the point of view, perhaps, of stalling at the tips—were going to be operated by the pilot to decrease the angle of attack of the tip in order to achieve these greater speeds?

MR. SHAPIRO said that when he was working on jet propulsion his boss used to say, when he did not want to commit himself, "A lot of people will be surprised." He felt the same answer applied to the speed of the helicopter. There was no doubt that the conventional answer had been given. There was an unconventional school of thought, however, which was not so certain that either compressibility or tip stall were going to be the problems. He had seen other opinions expressed by very serious designers. Just to show how interlinked all the factors were in helicopter design, it had been put out as the official opinion of the Bell Company that the problem was one of rotor weight. That seemed a very rational answer when one went into it.

As he saw it, the real problem was that we did not know how to streamline certain essential components of the rotor. He thought that was going to be by far the most difficult problem in designing for higher speeds. He would like to correct one figure mentioned: he thought that the unloaded rotor on such evidence as we had today—on the strength of model tests—could go to 250 m.p.h. without exceeding our knowledge; but with present methods of performance prediction we ran into an uncharted field at about 150 m.p.h. on pure helicopters and between 200 and 250 m.p.h. on unloaded rotors. Beyond that we had a lot to learn.

Dr. Heinrich Focke recently stated that in 20 years' time everyone will be able to have a helicopter costing no more than a light car. Do the team agree, and does this mean that no one could afford a light car?

MR. SHAPIRO said that this was to him something of an article of faith, and without the training of a minister it was difficult to communicate that article of faith. He had recently visited a friend who made racing cars, although perhaps a racing car was not exactly the type of light car which they had in mind. As he looked at this car he had visualized a light helicopter. Helicopters ought to be considerably cheaper; it was all a question of production. We had not really entered the realm of production, and predictions on this subject could be based only on integration of two fields of experience. One was the design of very expensive helicopters and the other was the translation of the design of a very expensive car into a popular car. There was no reason whatever why the helicopter should cost any more than a light car; in fact, there were many reasons why it should cost considerably less. Even with a mechanically driven helicopter (and this was by no means the only one which could be envisaged) the transmission was considerably simpler.

MR. FRISE thought that before we could consider relative prices we had to compare the relative quantities of production. Whatever faith we had in any form of flying machine he could not really see as many being used as were road vehicles on land; therefore, with the same production facilities, the cost would be higher. Against that we could offset the chance of making simpler drive systems. He had had in his little group some experience of looking into simpler forms of drive; none of them was quite so efficient as the piston engine, but all contributed to much lower first cost and maintenance cost of the vehicle. Some simplified form of drive could be used to produce a small helicopter in the same price class as a light car.

MR. WHITBY said that a thing to note about all aircraft was that if the engine stopped one came down again, whereas with you were merely left on the road. A higher standard of maintenance had to be applied to aircraft, which meant that if everybody who now had a private car had a helicopter, the rest of the people would be employed on maintaining helicopters. There was another objection to "a mass of aircraft." Anybody who tried to get into London nowadays would appreciate the amount of traffic congestion on the roads. Although it was true that the aircraft could move in three dimensions, one also moved out of sight of the kerb, so to speak; he could not see control of such traffic being a possibility.

MR. REED had no doubt that such a helicopter could be manufactured, and, as with cars, if the demand was there it would be cheap; but he did not think there would be such numbers flying.

Does the panel consider that since the A.R.B. require rotor blades to be replaced at a relatively short life, these blades should be designed primarily for cheapness of production, even at the cost of loss of some aerodynamic efficiency? In this connection, B.E.A.'s report and accounts for 1952-53 *stated that a set of rotor blades costing* £6,000 *for one of their helicopter types had to be renewed every* 150 *hours, whereas Bell's chief designer stated that some of the blades on Bell* 47*s were still running after* 4,000 *hours. To what cause must this difference be attributed?*

DR. HISLOP said that here we were up against the lack of experience of British helicopter designers in the field of producing lots of helicopters and lots of blades, combined with what might be termed the "native caution" of the A.R.B. The A.R.B. were a body who recommended whether the Minister of Civil Aviation should or should not issue a certificate for safe carriage of passengers or freight, and thus they were very circumspect in granting long lives, especially in early stages of development. Experience would show that as the British helicopter designers gained experience by building more helicopters, and built up the necessary background of hours, the lives of the blades would lengthen very appreciably and eventually approach something of the order of 2,000 to 4,000 hours; in that case one should not sacrifice aerodynamic efficiency. One should bend one's efforts to get at the basic problems which tended at the moment to restrict the lives. The Bell figures were probably correct, but might

HELICOPTER FORUM . . .

possibly have been in reference to military aircraft. There was no reason why, given the opportunity, British blades should not eventually reach such a figure.

MR. FRISE agreed, saying that, primarily, two things had to be done to increase life. One was to find something which would stop them from warping or changing their shape, such as corrosion by rain. This happened a lot to composite blades; it brought in vibration and then they had to be scrapped. The other thing concerned was fatigue in materials; those most suspect at the moment were light alloys. The most direct attack on the problem was to use stainless-steel blades.

With very few exceptions, pilots' controls in helicopters seemed to be designed as a curious modification of those on fixed-wing machines. There is virtually no transfer of skill, so is this necessary? Could not the controls be designed on principles derived from human engineering studies into the most natural and ergonomic system of human control over a multi-dimensionally-free machine? If previously learned skills and habits are of value to a helicopter pilot, why not use the control system of the motor car as a model?

MR. REED said that this was a sore point with him. One tended to get away from the fact that a helicopter was an aeroplane and came under the normal rules and regulations of orthodox aircraft. He could see no reason why an attempt should not be made to make it like an orthodox aeroplane from the point of view of normal controls; it was unnecessary to have extra controls. A desirable feature of design was a constant-speeding rotor, and once we had that we would do away with the throttle-cum-pitch control and return to a normal throttle lever; the collective lever in itself was the only difference from normal aircraft control. If one had a throttle and a constant-speeding rotor then the only difference would be in take-off, landing and emergency techniques.

MR. SHAPIRO recalled one design for which a very different control system was used—the Hoppicopter, in which a single control-organ did virtually all the controlling. It was arranged in a manner which seemed very logical, inasmuch as every motion of the aircraft was initiated by a replica motion of the hand of the pilot. He had closely interviewed the pilot who had had a great deal of fixed-wing experience, but no helicopter experience; this man had taught himself to fly on the machine.

From this experience, said Mr. Shapiro, his interpretation was that any control system was possible. He did not think we had enough comparative studies to arrive at a really well-founded distinction between control systems; in the past, departures from the orthodox method had been resented by pilots. What would happen to a novice on helicopters? He would not be likely to resent a new kind of control. The speaker believed there was very little to choose, and he could not see there were enough reasons to depart from what had already become conventional systems on helicopters.

(Part 1) Has any headway been made recently regarding blind-flying instruments? When will suitable instruments be available for commercial use, and in what way will they deviate from those used in fixed-wing aircraft. (Part 2) Supposing that the stability, instrument and automatic flying problems will be solved, and remembering that helicopters may be expected to operate in relatively close proximity to obstacles and local terrain, is there any reason to assume that limits for bad-weather operations will be lower than those for fixed-wing aircraft?

MR. REED said that there ought to be improvement in attitude-indication for the fore-and-aft condition of the airframe. At the moment the aircraft could apparently be climbing, yet in actual fact it was descending with nose up and tail down. That would be indicated on the present orthodox horizon, but by utilizing the rest of the instruments one would know what was going on. With orthodox instruments used collectively it was impossible to get into a position in which "you do not know where you are"; but it would take a lot of sorting out.

DR. HISLOP said there was no doubt that, to be worth while, commercial helicopters must be capable of flying at night and in bad weather conditions, probably to considerably lower limits than fixed-wing aircraft; and, from the experience of which he had knowledge, he thought there was no special reason why this could not be achieved with what were substantially orthodox instruments modified to suit the particular helicopter characteristics. He was very doubtful if there was a pressing need for any completely new instrument.

Where the A.S.I. was concerned it was a question of finding the correct source of static pressure. He believed an instrument could be obtained which would give satisfactory indication down to the speed range that was set. When the speed on a blind approach fell to 10 or 15 m.p.h., or even lower, the pilot would also have other assistance, such as electronic aids, to keep him on the correct heading and correct rate of descent.

MR. FRISE said that the designer's job was to make the helicopter very easily controlled and so stable that the problem of having an automatic control when on instruments was simplified.

MR. WHITBY, answering Part 2 of the question, said that the helicopter could operate to lower limits, generally speaking, but not in what was really the important matter—that of cloud ceiling. Being conservative and looking into the immediate future, he could not envisage anybody coming into London to land at a "submerged" site (or, for that matter, an elevated site with spires in the vicinity) when cloud was on the deck. He thought there would always have to be a fairly substantial cloud ceiling—in the order of 300ft—and blind flying would then primarily become a problem of moderately low-speed cruising, flying blind. In these circumstances, so far as one could make out, and if the flying characteristics of the aircraft were improved, the existing basic fixed-wing blind-flying panel would be adequate. It would not be so if one attempted to hover or fly at very low speed without external reference, but he was not convinced that this would be a necessity. Obviously, the pilot approaching with any sort of wind, was going to get an entirely wrong impression of his flight path if he was flying at the speeds indicated by his A.S.I. Air speed was not of great importance to flight path at low speeds.

MR. REED said that the matter really revolved around stability. If stability was comparable with that of the fixed-wing machine it would be easier to say "yes" to the ordinary blind-flying panel.

City planning and the various means of surface travel are already inadequate to meet traffic requirements. The helicopter provides the future answer to most problems of speedy transport from one part of a city to another, and from city centre to airports. But if a city were to be designed from the outset to take advantage of projected means of surface transport, diesel trains and cheaper electricity from atomic power, would the helicopter be likely to prove as economical or even as fast as surface alternatives?

DR. HISLOP said that were a city being planned from the outset—he cited a new city being built in India—an airport on the outskirts could be served by a surface transport system which would be almost as fast and certainly more economical for transport of large numbers of passengers than a large helicopter. That might sound heretical, but he thought it could be done. One could visualize the equivalent of an express tube or surface train system which could cover the distance in a very short time and very economically.

MR. WHITBY was broadly in agreement but said the initial outlay of a tube system was expensive. Above-ground trains were much cheaper, but he thought it cost about £1 million a mile to build a railway. It would probably be worth while, however, in the long run.

MR. SHAPIRO dissented from this view. A curve demonstrating the power required to propel a motor car showed that at about 80 m.p.h. most of the power was absorbed in overcoming air resistance. The same thing applied to a helicopter and, for that matter, to an aeroplane. This resistance had to be overcome, whatever vehicle was considered; and the remainder, which was small, was all that mattered in the difference between the motor car, the helicopter, the aroplane and the train. He did not believe that this small difference could make up for the enormous installations which would be required to bring surface transport to the speed of a helicopter or an aeroplane.

Does the Brains Trust agree that present-day helicopters, and those which are likely to appear in the foreseeable future, must inevitably depend for their safety on a rotor system subject to intense cyclically-fluctuating stresses? If so, does the panel agree that the helicopter must be considered for some time as inherently less safe than a fixed-wing aircraft?

MR. WHITBY said that this was really a design matter, but the helicopter must, he supposed, be inherently less safe. This did not mean that, provided one was prepared to pay the penalty in extra robustness to have a reserve factor to cater for any fatigue, the helicopter could not be made practically as safe as fixed-wing aircraft. That was one of the economic penalties which the helicopter had to pay for the ability to fly at low speeds.

DR. HISLOP thought that this question had a bearing on that concerning the A.R.B. and life of rotor blades. If we could design blades to give satisfactory lives of the order he had mentioned earlier, the general safety-level in cruising flight would be comparable with that of fixed-wing aircraft. He was sure that, when close to the ground, the helicopter was very much safer than a fixed-wing aircraft ever would be. In the long run it would be shown that the helicopter was a safer vehicle.

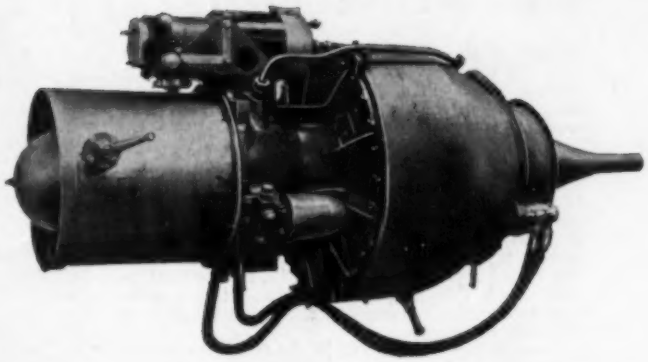
MR. REED asked how one came to a conclusion as to what a degree of safety was. The only way in which one could say that the helicopter was less safe than the ordinary aeroplane was if we had had accidents caused by cyclical oscillations; and he could not think of one.

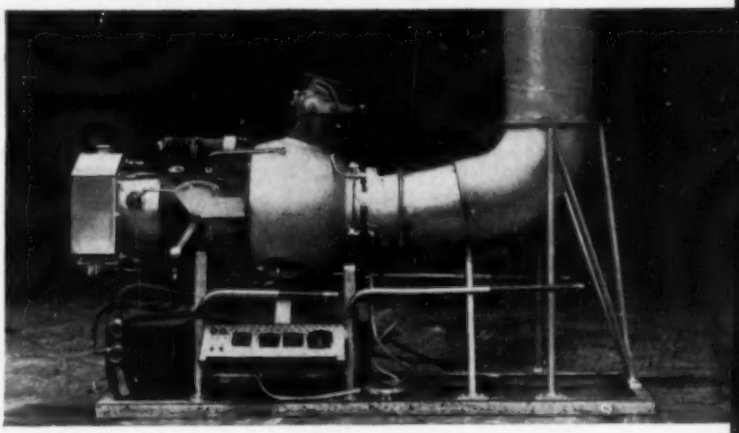
MR. SHAPIRO heartily agreed with Mr. Reed. Nine-tenths of all accidents had non-structural causes, and in these the helicopter was so much in advance of fixed-wing types that whatever difference there was in structural matters was completely insignificant.

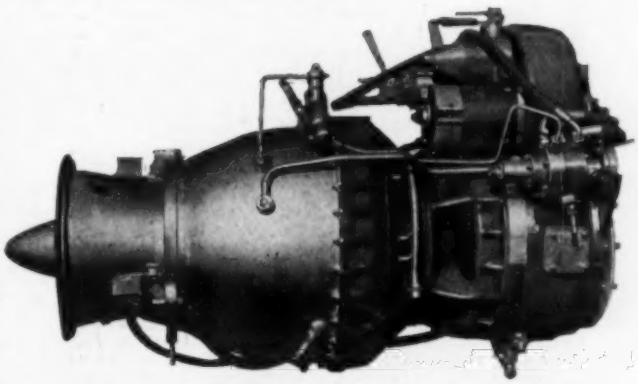
(The remaining questions and answers will be printed next week)

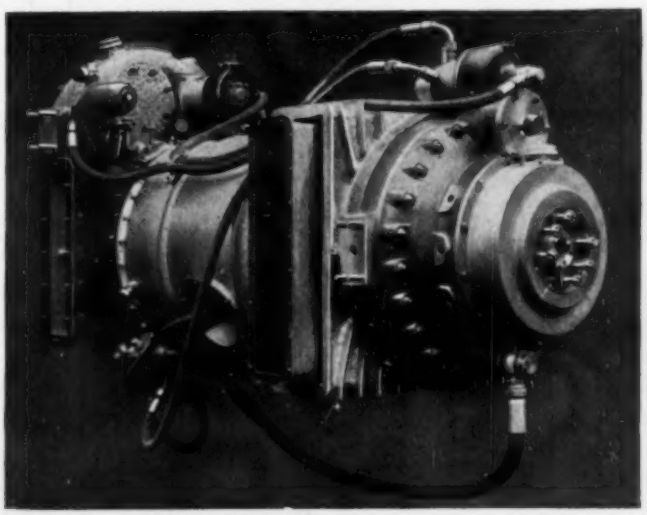
SMALL-TURBINE QUARTET

Progress in Turboméca Production at Brough : Aeronautical and Industrial Applications









AT the Brough works of Blackburn and General Aircraft, Ltd., plans are now well advanced for the production under licence of four of the Turboméca light gas turbines—the Palas, Palouste, Artouste and Turmo. Complete engines supplied by the manufacturers from France, as well as some assembled from parts from the same source, are being bench-tested at Brough to check performance and to gain operating experience. Although assembly in the immediate future will be from parts supplied from France, preparations are in hand for complete production at Brough. Experimental machining of parts is in fact being undertaken at the moment, in the shop where Cirrus Bombardier and Foden diesel engines are being made.

The whistle and roar of one or other of the small turbines can be heard in the factory throughout the working day. A Palouste has already completed 900 consecutive running hours during daylight in its open-ended test pen. Its performance in these conditions has proved to be slightly better than that quoted by the makers. To reduce the noise of testing, and thus to allow the turbines to be operated 24 hours a day without disturbance, a new engine-running block has just been completed. It contains two cells, at each end of which splitters and silencers greatly reduce the volume of sound reaching the outside world. The splitters and the control room walls are soundproofed with a fibrous material known as Stillite; the intake and outlet ends of the cells are automatically closed by electrically operated shutters and the cells filled with inert gas in case of fire. A Palas is at present being run in one of these cells.

The Palas is a pure jet of 350 lb thrust; the Palouste, an air-compression engine which, from a compressor delivery bleed, produces 135 lb/min of air at 41.2 lb/sq in gauge at 15 deg C; the Artouste, a geared shaft-drive unit with an output of 276 h.p. (Mk 1), or 394 h.p. (Mk 2), with two alternative shaft speeds, 6,000 and 12,000 r.p.m.; and the Turmo is a free turbine shaft-drive engine producing 270 h.p. (Mk 1) and 400 h.p. (Mk 2). Although most of these engines have been airborne (the Palas in various French light aircraft, the Palouste in the S.N.C.A.S.O. Ariel helicopter, and the Artouste in the S.N.C.A.S.O. Farfadet helicopter), experimental applications in England have been mainly industrial. However, two Palas, supplied direct from France, power the Miles Sparrowjet (these engines were recently at Brough for a routine check); and two more Palas supplied by Blackburn and General are installed in the Short Sherpa.

The industrial applications are so interesting that some, at any rate, are worthy of mention here. The most significant use has been made of the Palouste, one of which was installed in a mobile rig at the entrance to dock gates at Dover. The outer gate had been removed for maintenance, and the inner gate could not be operated in a heavy swell. The Palouste was therefore used to pump compressed air through piping to the bed of the dock entrance; the mass of bubbles rising to the surface reduced a 4ft swell to a mere 18in. Another application was at Hebburn, Newcastle-on-Tyne, where a Palouste was used to drive a Jacobs emergency water pump delivering 3,000 gal/min. A diesel compressor could quite well have supplied the same

From top to bottom, the Palas pure jet, Palouste air compressor, Artouste geared shaft-drive engine and Turmo free-turbine shaft-drive engine. The Palouste is mounted on its transportable frame, with fuel tank beneath the engine and compressed-air delivery, and valve, over the combustion chamber. The drive shaft of the Artouste emerges from the right-hand end of the engine. The Turmo is seen from the drive-shaft end, with the left efflux port nearest the camera; the left-hand air intake can be seen forward, next to the accessory drive case.

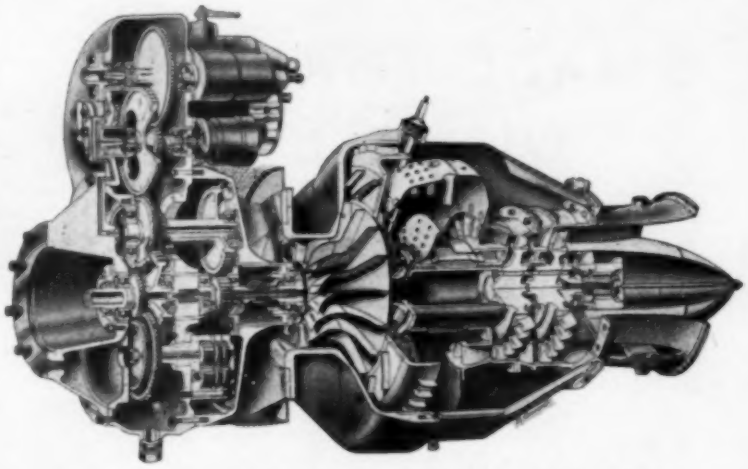
SMALL-TURBINE QUARTET . . .

pressure of air with smaller fuel consumption, but it could not have provided the large volume of which the Palouste is capable. The Palouste is also much more compact than a comparable diesel and more easily transportable in its "self-contained package."

The Turmo, though following the general principle of the Turboméca turbines, has, more than any of the other engines, an "industrial" appearance. Intakes and effluxes face laterally on each side, and the castings appear slightly heavier than usual. The shaft drive emerges from the rear of the engine when looked at in the normal aeronautical sense. The unit would appear to be well suited to marine installations and a Turmo is, in fact, at the moment being evaluated at the Admiralty Research Station at West Drayton, Middlesex.

Though applications will in the future be mainly industrial, further purely aeronautical applications will probably follow in the near future. Palas auxiliary jet units built at Brough may also be sold in Australia, where Queensland Airlines, Pty., Ltd., have been appointed distributors and factory representatives by Aerocontacts, Ltd., of Gatwick Airport, Surrey, who hold the British Commonwealth concession for this engine.

On the aircraft side, also, the Yorkshire factory is very busy, and those who associate "Brough" only with the Universal would be surprised at the variety of other construction in hand. Notes on these activities were given on p. 128 of *Flight* last week.



Interior arrangement of the Artouse, showing the comparative simplicity of the Turboméca principle. Turbine wheels and blades are cut from the solid and fuel is injected into the annular combustion chamber by centrifugal force through holes in the hollow mainshaft, along which the fuel is led. The air intake is in front of the compressor wheel.

"AGARD" PAPERS IN BOOK FORM

FROM the Paris offices of AGARD (Advisory Group for Aeronautical Research and Development) comes news of "a flood of requests" for copies of papers read at the recent conference on aspects of combustion, convened by AGARD at Cambridge. The enquiries followed the publication of summaries in our issues of December 18th and 25th, and an American executive of the organization writes that he "had no idea that *Flight* was so widely read in technical circles in the U.K. and in France."

AGARD have decided to produce a bound volume of their papers and discussions. It is due to appear in April, and all NATO countries will receive "a sizeable number of copies for subsequent free distribution through regular channels." United Kingdom enquiries, it is stated, should be addressed to "Ministry of Supply, TPA3/TIB, Room 009B, First Avenue House, High Holborn, London, W.C.1," and marked "for the attention of Mr. A. H. Holloway." The corresponding address in France will be "ONERA (Direction), 25 Avenue de la Division Leclerc, Chatillon-sous-Bagneux (Seine), Paris."

POWERFUL TRACTOR

ILLUSTRATED below is a four-wheel-drive tractor, the Douglas TugMaster, which has a number of features that will appeal to aircraft constructors, airline operators and others concerned with the expeditious handling of aircraft in hangars and on tarmac.

Powered with the eight-cylinder-in-line Rolls-Royce B.80 petrol engine developing 160 b.h.p., the TugMaster exerts 22,000 lb tractive effort, and can move a trailed weight of 210,000 lb at the very useful speed of 15.1 m.p.h. Minimum speed is 1.05 m.p.h. (at maximum torque) and the tractor can be driven "solo" at up to rather over 34 m.p.h.—another time-saving factor in aircraft handling.

The Douglas TugMaster (see above) takes on Avro Vulcan in tow.

Two gearboxes are employed, an epicyclic, fluid-flywheel self-change type giving four ratios and reverse, and a two-speed auxiliary box with two ratios. Tyres are 11.00 × 20 Trakgrips, single on the front wheels and twin on the rear. Hydraulic braking is provided, with air-pressure control, and among detail items of equipment is an air reservoir governed at 160 lb/sq in for tyre inflation and similar purposes. The body allows accommodation for four passengers and provides locker-space for towing-cables; it also includes ballast containers which permit sand or gravel to be scattered under the wheels when operating under slippery ground conditions. The electrical equipment, which includes lighting, is fully screened.

Wheelbase is 9ft 3½in and overall dimensions are: width, 8ft; length, 20ft; height, 7ft. The makers are Douglas Equipment, Ltd., Kingsditch Lane, Tewkesbury Road, Cheltenham.

FORTHCOMING EVENTS

Feb. 5. Photogrammetric Society: "New Plotting Machine for Air Photographs," by J. E. Odle.
Feb. 6. British Interplanetary Society: "Progress towards Astronautics," by K. W. Gatland.
Feb. 10. Radar Association: "Some Unsolved Radar Problems," by K. E. Harris.
Feb. 11. R.Ae.S. Main Lecture: "Recent Developments in the Structural Approach to Aeroelastic Problems," by Dr. D. Williams, M.I.Mech.E., F.R.Ae.S.
Feb. 12. A.T.A. Association: Annual reunion dinner.
Feb. 13. British Interplanetary Society (Midlands Branch): "Astronautical Physics," by N. H. Langton, Ph.D.
Feb. 13. British Interplanetary Society (Provisional Yorkshire Branch): "Some Experimental Work on Rockets," by D. N. Hunter.
Feb. 18. R.Ae.S. Section Lecture: "Helicopter Research," by F. J. O'Hara, A.R.Ae.S. (jointly with the Helicopter Association).
Feb. 20. British Interplanetary Society (North-west Branch): "Building the Lunar Base," by R. A. Smith.
Feb. 23. R.Ae.C.: Film Show.
Feb. 24. R.Ae.C.: Dinner to speed and height record holders.
Feb. 24. R.Ae.S. Graduates' and Students' Section: "Aircraft Plastics", by Lorne Welch.
Feb. 25. Aerodrome Owners' Association: Annual general meeting and dinner.
Feb. 26. Institute of Transport: Annual dinner.
Feb. 27. British Interplanetary Society (Provisional Western Branch): "Provisioning of Interplanetary Vehicles," by G. L. Garthwaite.
Mar. 2. R.Ae.S. Section Lecture: "Metal Sandwich Construction," by F. Tyson, B.A., A.F.R.Ae.S.

R.Ae.S. Branch Fixtures (to Feb. 26).—Feb. 6, *Birmingham*, annual dinner. Feb. 8, *Halton*, "Flight Simulators," by G. H. Hellings. Feb. 9, *Belfast*, "Engineering Problems of Airline Operation," by B. S. Shenstone. Feb. 10, *Weybridge*, "Navigational Aids," by W/C G. N. Mackintosh, O.B.E. Feb. 12, *Glasgow*, film show (including "Story of the Century").

Feb. 15, *Halton*, junior members' night. Feb. 16, *Belfast*, "Short Analogue Computer," by E. Lloyd-Thomas. Feb. 17, *Coventry*, "Development of Bristol Proteus Engine," by Dr. S. G. Hooker; *Manchester*, "Rocket Power Plant," by S. Allen.

Feb. 18, *Leicester*, "Present Trends in Aircraft Materials and Construction," by W. A. Baker.

Feb. 23, *Belfast*, "Engineering Aspects of the Flutter Problem," by N. P. Shevloff. Feb. 24, *Weybridge*, "Shape of Wings to Come," by D. Keith-Lucas. Feb. 25, *I.O.W.*, "Accident Investigation," by A. Cdre. Sir Vernon Brown. Feb. 26, *Birmingham*, "Development of the Vickers Viscount," by A. Greenwood.

THE Cullum Detuner

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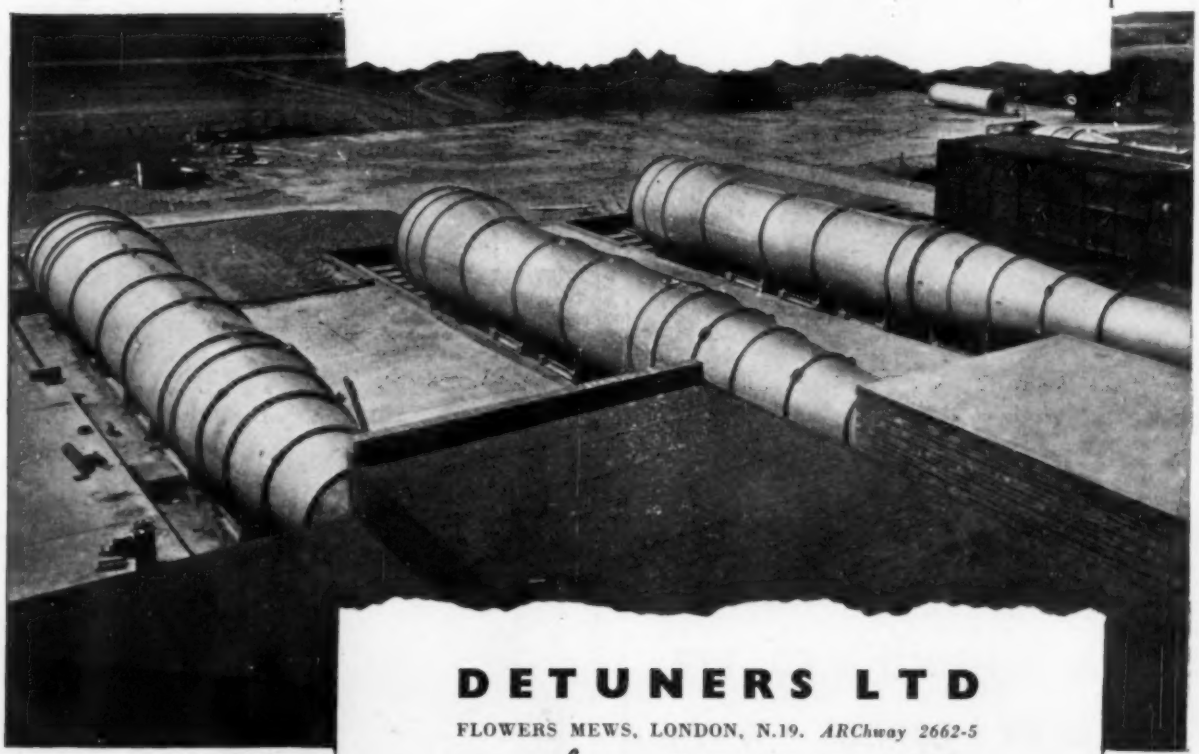

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VAMPIRE TRAINER

More Details of Handling, Performance and Maintenance

Vampire Trainer and its ground-servicing equipment—refueller, air bottles and battery trolley. The equipment is similar to that for other de Havilland fighters.

REFERENCES in *Flight* to the de Havilland Vampire Trainer, since the inception of that excellent private-venture side-by-side two-seater in 1950, have been frequent, which is not surprising in view of its popularity among instructors, pupils and ground staff, and its widespread adoption by overseas air forces. (It is already serving, or is about to serve, in 30 air forces throughout the world.) Particularly detailed were the description and cut-away drawing in the issue of May 8th last year, and a first-hand account of flying characteristics two weeks later. Now, from the makers, comes some new material concerning handling and performance.

The aircraft, it is stated, is cleared for intentional spins, which it will perform readily at all altitudes up to its ceiling. Rotation is described as quite slow, with the characteristic "rough ride" of modern fighters. Normal action ensures rapid and positive recovery without great loss of height; for example, from the beginning of a two-turn spin to complete recovery this is usually about 4,000ft.

The low wing-loading, as is well known, affords excellent manœuvrability at the highest altitude. Specifically, without external tanks, a radius of turn of 0.95 nautical miles can be achieved at a Mach number of 0.7 at 40,000ft.

"The symptoms of compressibility," the de Havilland statement continues, "can be adequately demonstrated to the pupil, as well as the behaviour of a high-performance aircraft when flown to its limits. The limiting indicated Mach number of the clean aircraft is 0.805, 0.10 higher than the Vampire fighter, due mainly to the better fineness ratio of the longer two-seat fuselage. At about 0.75 indicated Mach there is a slight nose-up change of trim, followed at 0.80 Mach at medium and high altitudes by buffeting. When 0.805-0.81 Mach is reached there is a nose-up pitch and the aircraft tends to recover from the dive." The operational ceiling of the clean aircraft is quoted at 40,000ft, and this height can be reached in 16.3 minutes. With external tanks in place the ceiling is 34,000ft and the time of climb 17.5 minutes.

The claim that particular attention has been paid to maintenance accessibility is borne out by the photograph above. Much of the equipment requiring regular attention has been housed in the nose compartment, and a useful feature is that the aircraft can be refuelled, rearmed and prepared for a sortie quickly and without ground staff getting in one another's way. Maintenance checks are straightforward, and ground equipment and spare parts are generally similar to those of other de Havilland fighters, affording economy of operation to air forces standardizing on the types.

SMOKE-BOMBING THE TSETSE FLY

Extermination Experiment in Africa

AT the request of the Ministry of Supply and the Colonial Office, Tiltman Langley Laboratories, Ltd., of Redhill Aerodrome, Surrey, are developing a means of combating the tsetse fly in Central and East Africa. The method chosen involves the dropping of pesticidal-smoke canisters from aircraft.

The tsetse fly, carrier of trypanosomiasis (sleeping sickness) has laid barren about four million square miles of potentially fertile land in Central and East Africa. In fact, the whole of Central Africa between the southern edge of the Sahara Desert and central Southern Rhodesia is infected.

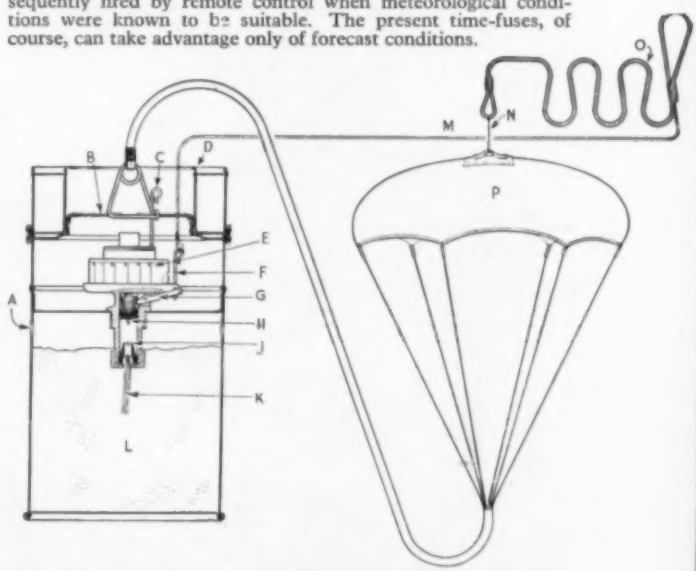
Ameliorative action can be taken by killing off game in the affected area, in order to prevent spread of the disease, or by clearing the vegetation in which the fly breeds; but these measures upset the processes of nature and lead to disastrous soil erosion. It is also considered ineffective to spray insecticide from the air, since the flies breed beneath the cover of foliage.

Tiltman Langley, in conjunction with I.C.I., Ltd., Lea Bridge Industries, Ltd., the Metal Box Co., Ltd., and Smiths English Clocks, Ltd., have developed the smoke generator illustrated here. It is intended to drop such generators under small parachutes from an aircraft of the Bristol Freighter type, flying at about 400ft and at a speed of between 120 and 200 m.p.h. By this means, approximately 1,285 canisters could be distributed over 12 square miles in 1½ hours. Time fuses would cause the whole pattern to begin smoking at the same moment, and in the most suitable meteorological conditions for the area. Canisters dropped by day would be set to function by night, when air convection currents, which would otherwise dissipate the smoke, are weakest.

Following a survey recently carried out by Mr. Marcus Langley (managing director of Tiltman Langley Laboratories) in East Africa, it was decided that the "bombing" aircraft should be based on airfields along the main railway lines leading inland from the ports of Mombasa and Dar-es-Salaam. For other areas Sunderlands or Catalinas might be based on the harbours of Mombasa, Dar-es-Salaam and Lindi, and on the lakes of Rudolph, Victoria, Albert, Tanganyika and Nyasa.

The behaviour and habitat of the tsetse fly have been studied on the spot and the smoke generator has now been tested in England. Operational trials in Africa will be the next step. One of the problems which had to be solved was the protection of the canister from damage on striking the ground. It has been found that with the parachute, which gives it a falling speed of 50ft/sec, it can be dropped on concrete without sustaining serious damage.

A later development may be the use of radio-controlled fuses in the generators. By this means a pattern could be laid and subsequently fired by remote control when meteorological conditions were known to be suitable. The present time-fuses, of course, can take advantage only of forecast conditions.



Internal arrangement of the smoke generator and its parachute stowage.
(A) Smoke vent. (B) Cruciform lid. (C) Timing pin. (D) Annular stowage for parachute and lines. (E) Timing mechanism. (F) Arming pin. (G) Spring lever to release striker (H) on to percussion cap (J), so igniting quickmatch (K) leading to 6 lb smoke charge (L). Parachute assembly: (M) arming-pin cord attached to (O) static line which extracts (P) 21in canopy connected by weak link (N).

PROSPECT FOR 1955: Two Britannias are now flying and the type is expected to enter revenue service with B.O.A.C. next year. An estimate of the outstanding range-payload performance expected of this turboprop airliner is quoted below. An interesting feature of this new aerial study is the effect produced by painted bands near the tips of the D.H. hollow-steel airscrews (diameter 16ft).

CIVIL AVIATION

BRITANNIA ROUTE ANALYSIS

AN impressive picture of the commercial capabilities of the developed Bristol Britannia 300 with 4,150 e.h.p. Proteus turboprops is painted in the latest edition of *The "Bristol" Quarterly*. The journal publishes an analysis of the Britannia's estimated performance on a 9,928-mile international route—between London and Tokyo. This is flown in five stages, with stops at Cairo, Karachi, Bangkok and Manila. Although long by normal standards, these sectors are described as modest when measured against the maximum range ability of the Britannia.

Carrying a capacity payload of 104 passengers, baggage and freight, the aircraft would complete the outward journey in just under 28 hours' flying time. With refuelling stops of 45 minutes each, the elapsed time between London and Tokyo would be only 31 hr; and the return journey, because of stronger headwinds, would be 38 hr 45 min. No estimates are made of operating costs but the manufacturer's journal claims that "no aircraft yet existing could do this job more cheaply than the Britannia."

Wind values assumed in the analysis are taken from *Meteorological Report No. 7*, and are those found on 85 per cent of days in the least favourable quarter of the year. Thus, a headwind of 82 m.p.h. is assumed on the Bangkok-Karachi stage; even so, it is stated that the Britannia would fly this 2,300-mile stage with a full complement of 104 passengers.

An extract from the analysis is quoted below, showing the figures for a typical stage of the return journey:—

Stage: Tokyo-Manila (1,860 st miles): Cruise procedure, 285 m.p.h. I.A.S.; mean wind, −44 m.p.h.; take-off weight, 154,353 lb; landing weight, 120,483 lb; stage fuel, 32,400 lb; reserve fuel, 10,930 lb; payload, 26,680 lb (104 passengers with baggage plus 2,680 lb freight); block time, 5 hr 53 min; block speed, 315 m.p.h.

Three cruise procedures were used in the analysis: (i) maximum speed at 285 m.p.h. IAS, (ii) intermediate speed at 260 m.p.h. IAS, and (iii) long-range procedure at 345 m.p.h. TAS. In each case the speed chosen was that involving no payload limitations. In practice, operators would use a more flexible method of cruise control whereby the aircraft would always be flown at, or close to, the optimum speed.

Fuel allowances and reserves were as follows: starting and taxying, 530 lb; take-off, 355 lb; de-icing, 1,115 lb (approx. 3 hr); engine and airframe depreciation, etc., 5 per cent of stage fuel. Reserves: 373 miles at long range cruise procedure against 58 m.p.h. headwind—two hours' stand-off using two engines with two idling. Time allowance: 0.25 hr for taxying, etc.

AEROFILMS' NEW VENTURE

AT a reception held last week Aerofilms, Ltd., announced the introduction of aerial colour photography on a commercial scale. Examples on display included a number of 5in by 5in Ektachrome transparencies and some coloured enlargements made from them by the Carbro process. The transparencies were wonderfully bright and critically sharp in outline. With a high-power magnifying glass separate blooms could be distinguished in an aerial view of a large nursery. Of aeronautical interest was one of the assembled aircraft on the runway at Farnborough during last year's S.B.A.C. Display.

As would be expected, the enlargements lose a little of this wonderful crispness of outline. The Carbro process requires the superimposition of three or four prints made in the primary colours of the spectrum and this causes the very tiniest details to disappear. They compare, however, very favourably with a normal enlargement of the same size.

Announced at the same time is the compilation of a classified index to the more than 100,000 air photographs taken by Aerofilms, Ltd., since Mr. F. L. Wills, now the managing director, first started the concern in 1919. This is the work of the librarian, Miss T. Hamilton-Jones, M.B.E. The examples used as illustrations make it a most striking volume in its own right far removed from any "index" in the ordinary sense of the word.

Aerofilms, Ltd., is one of the Hunting Group of companies, which has aerial survey concerns in Africa, Canada, New Zealand and Australia.

COMET 2 PERFORMANCE

ON the basis of preliminary flight tests with the Avon-powered Series 2 Comet, the de Havilland Aircraft Co. has published a statement in which the performance of this developed version of the world's first jetliner is related to the requirements of everyday commercial operation. It is immediately apparent that from the viewpoint of range—and in many other respects—the Series 2 represents an enormous improvement on its predecessor. It is capable of handling stage-lengths of up to 2,400 miles with a full complement of 44 passengers, and is thus capable of regular operation on most of the world's main international routes.

Two recent flights by the first production Comet 2 for B.O.A.C. left little doubt that the original brochure figures were conservative. On January 22nd, flying non-stop from Hatfield to Khartoum for tropical tests at an average speed of 481.1 m.p.h., it completed the 3,080-mile journey with 1,200 gallons of fuel left in the tanks. Six days later the same aircraft flew non-stop from Khartoum to Johannesburg, a distance of 2,913 miles, at 460 m.p.h.; on this occasion the amount of fuel remaining was sufficient for a 400-mile diversion from sea level plus 30 minutes' stand-off. Both flights were made with an equivalent payload of 10,500 lb, corresponding to 44 passengers with baggage.

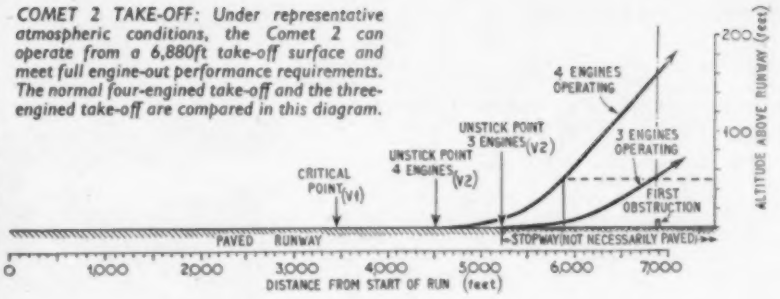
After taking into account the severe fuel-reserves policies enforced by commercial operators (B.O.A.C., for example, allocate about one-third of the Comet 1's fuel capacity for diversion, stand-off and emergency, and their sector fuel estimate includes a 5 per cent allowance for performance variation and navigational error), it remains evident that stages of well over 2,000 miles are well within the Comet 2's capacity.

The decision to adapt the original Comet to take advantage of the axial-flow Rolls-Royce Avon turbojet, with its higher thrust and lower fuel consumption, was taken in July 1950. Flight testing has been in progress since February 1952 with a prototype obtained by equipping the sixth Comet 1 airframe with Avons. The production Series 2 embodies several innovations, including a slightly longer fuselage, greater fuel capacity and, not least, a new wing section which greatly improves slow-flying characteristics. Combined with the extra thrust of the Avons, it has given

the Comet 2 a better take-off and landing performance despite the increase of all-up weight—from 107,000 to 120,000 lb.

The manufacturers state that the development of the Avon has been more rapid than was expected. Those installed in the Comet 2 are approved by the A.R.B. with a nominal test-bed thrust of 7,150 lb, and Rolls-Royce believe that a period of 1,000 hr between overhauls will soon be achieved in airline service—a figure which compares well with those quoted for modern compound piston engines. As originally offered for the Comet the Avon had a sea level static rating of 6,500 lb, and an increase to 7,000 lb was not then expected before the completion of a year of civil operation.

COMET 2 TAKE-OFF: Under representative atmospheric conditions, the Comet 2 can operate from a 6,880ft take-off surface and meet full engine-out performance requirements. The normal four-engined take-off and the three-engined take-off are compared in this diagram.



Capacity payload of the Comet 2 is 13,450 lb, which is equivalent to 44 passengers with baggage and some 3,500 lb of freight. Assuming realistic fuel reserves and making allowance for headwinds not exceeded on 85 per cent of days in the year, the following routes are typical of those on which the aircraft can operate with a full load. The airport temperatures assumed are the average of the daily maxima in the hottest season. It will be seen that in each case there is a useful margin between the estimated take-off weight and the permitted a.u.w.

	Stage distance (st. miles)	85% Head-wind (m.p.h.)	Take-off weight required (lb)	Max. permis. take-off weight (lb)	Journey time (hr min)
Caracas-New York ...	2,116	47	115,500	120,000	5 19
Entebbe-Cairo	2,080	14	113,900	120,000	5 01
Perth-Djakarta ...	1,876	24	110,900	116,000	4 40
Karachi-Beirut ...	1,992	97	117,000	120,000	5 25
Entebbe-Johannesburg	1,846	22	109,400	120,000	4 34

Three more route studies show a payload limited by runway length, but here it is emphasized that the conditions shown represent a severe combination of headwinds, take-off temperatures and high load-factors—which, in practice, would rarely be met. Peak temperatures, for example, are often avoided.

	Stage distance (st. miles)	85% Head-wind (m.p.h.)	Payload (lb)	Max. permis. take-off weight (lb)	Journey time (hr min)
Kingston-Montreal ...	1,915	14	10,300	103,000	4 37
Paris-Dakar	2,610	24	12,300	118,500	6 30
Barbados-New York ...	2,100	36	11,500	111,600	5 14

Strong prevalent winds, or sector distances at the extreme end of the working range, can also affect payload. But although there is an 85 per cent frequency headwind of 64 m.p.h. on the 2,414-mile route between San Francisco and Honolulu, de Havilland quote a payload of 10,970 lb. Between Lima and Mexico City (2,650 miles, 20 m.p.h. headwind) payload is restricted to 7,200 lb.

The makers also put forward a strong case for the Comet 2 on shorter hauls where a need arises for a high-speed luxury service. Between New York and Miami, for example, the journey times would be 2¼-3 hr—compared with existing schedules of 4 hr.

Without graphs or tables it is not possible to express fully the take-off performance of a modern commercial aircraft. The take-off distance to a height of 50ft (with one engine failing at the critical point) is subject to the influence of variations in take-off weight, temperature, runway gradient and surface wind. However, an indication of the Comet 2's take-off performance under "representative conditions" is given by the diagram reproduced above. In this case the take-off distance available is 6,880ft, and the Comet is seen to clear 50ft after failure of the critical engine at the critical speed at its full take-off weight of 120,000 lb. Paved runway comprises only 80 per cent of the available distance; the rest of the take-off is made over the stopway, a surface sufficiently strong to accommodate the aircraft in the event of an abandoned take-off.

In normal circumstances the aircraft does not make use of the full take-off distance, which, in accordance with performance requirements, is calculated on the basis that the critical engine *will* fail. With all four Avons operating the Comet unsticks in 66 per cent of the distance available and, as shown in the diagram, clears the hypothetical 50ft screen in 85 per cent of the distance.

Further details of take-off performance, in terms of different combinations of altitude, temperature, weight and distance available, are quoted below:—

Altitude	Temp. (deg C)	Take-off weight (lb)	Take-off distance (ft)
Sea level	15	120,000	6,340
Sea level	45	120,000	8,250
3,000ft	25	119,000	8,460
5,000ft	20	114,500	8,600

These figures should help to dispel the tendency to associate jet airliners as such with abnormal runway requirements. In fact, the Comet 2 has a better take-off performance than the Series 1, and both types are comparable in this respect with conventional piston engined airliners in the same all-up-weight categories. Moreover, de Havilland state that under the 1951 B.C.A.R.s [which are accepted as the most advanced performance code yet enforced] the Comet 2's climb requirements are never likely to restrict the maximum permissible take-off weight to a level below that determined by aerodrome length. Because of its exceptional rate of climb on three engines at 120,000 lb, the Comet 2 meets the regulation (second segment) take-off climb requirement up to 9,700ft and a temperature of 25 deg C.

With its high block speed, and incorporating the lessons of nearly two years of passenger service with Series 1s, the Comet 2 emerges as an economically attractive airliner in its own right. Its manufacturers affirm that the Series 2 and the Series 3 (the prototype of which will fly this year) must be regarded as stable companions rather than as rivals. The Comet 2 is available for reasonably quick delivery, and there are good prospects for orders additional to those already placed by operators in Britain, Brazil, Japan, Argentine, France and Canada.

FAMILIARIZATION: Four executives of Air-India International study the Comet training mock-up at Hatfield: (left to right) Mr. E. M. Landford, the company's representative at L.A.P.; Mr. A. C. Gazdar, operations manager; Mr. C. Vishuanath, assistant operations manager; and Mr. R. Oza, chief flight engineer. The airline has ordered two Comet 3s.

FLIGHT SAFETY FOUNDATION

FROM a correspondent in New York we have received a summary of the 1953 activities of the Flight Safety Foundation. This shows that the Foundation's *Accident Prevention Bulletin*, of which there were 28 separate issues last year, now has a circulation of over 6,000. *Pilots' Safety Exchange Bulletins* were distributed on a similar scale, bringing the total number of these two publications to over 200,000. Other bulletins were published for mechanics (over 15,000 copies of each issue were requested by industry) and for private and agricultural pilots. The F.S.F. also launched Howard Kurtz's invaluable study of passenger psychology *The Common Man Up In The Air*, of which at least 45,000 copies have been distributed (the total quantity is unknown because I.A.T.A. and A.L.P.A. have permission to reprint and distribute it). Two other publications giving useful advice were

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Hail (10,500 copies) and *The Mountain Wave* (3,200 copies, mainly for airline pilots). Two other notable achievements were the organization of safety seminars at Cranfield last September, and at San Bernardino, California, in December.

Our correspondent affirms that the Foundation, energetically directed by Jerome Lederer, has done a great deal of good in America. He suggests that ". . . in some ways an English offshoot, tied not necessarily by name or finance, but with a close liaison and exchange of information (which would draw on Continental experience) might be worth thinking about."

ROYAL CONSTELLATION

SPECIALLY modified to provide personal cabin quarters for its Royal passengers, Qantas Constellation VH-EAF will carry Her Majesty the Queen and H.R.H. the Duke of Edinburgh on six of the 35 flights to be made during the tour of Australia. The airline's flight superintendent, Captain D. F. MacMaster, who has flown over 3m miles since learning to fly in 1933, will command the aircraft. His crew will be as follows: Capt. R. A. Bruce, 1st/Off. D. G. Harden, N/Off. J. L. B. Cowan, R./Off. A. M. Saxby, Eng/Off. G. W. Squires, Eng/Off. G. Reik, Stewardess M. de Tracy and Stewards K. O'Flaherty, H. Smith and S. Preece.

The journeys which Her Majesty will make in the Qantas Constellation are as follows: March 9th, Melbourne to Brisbane (890 miles); March 12th, Brisbane-Townsville (730 miles); March 18th, Brisbane-Broken Hill (736 miles) and Broken Hill-Adelaide (253 miles); March 26th, Adelaide-Kalgoorlie (1,058 miles) and Kalgoorlie-Perth (334 miles).

FIRST TEAM: Capt. D. F. MacMaster (left) and seven other members of the crew of eleven chosen to man the Qantas Constellation in which H.M. the Queen will fly next month. On the left of Capt. MacMaster are Capt. Bruce, N/Off. Cowan, R/Off. Saxby, Steward Smith, Steward O'Flaherty, Steward Preece and Stewardess de Tracy.

BREVITIES

ON February 13th Uruguay will become the 63rd member nation of the International Civil Aviation Organization.

* * *

The conditions under which non-scheduled flights may be made to various destinations overseas are summarized in *Civil Aviation Information Circular No. 12/1954.*

* * *

With the inauguration of "The Jamaican"—a weekly first-class service by a 60-seat Stratocruiser—on January 23rd, B.O.A.C. are operating for the first time non-stop services between New York and Montego Bay, Jamaica.

* * *

Sabena have officially denied the report, published in both British and Belgian newspapers, that an experimental helicopter service will shortly be operated between Brussels and London with S-55s.

* * *

The French independent airline Aigle Azur has become the 70th member airline of I.A.T.A. Four other companies—Airwork, Ltd., Air Vietnam, Japan Air Lines and Jugoslovenski Aero Transport—have joined the I.A.T.A. clearing house at London, bringing its total membership to 40.

Last year American Airlines, the world's largest air transport company, became the first airline to fly more than 3,000m passenger-miles in a year; the total of almost 3,290m represents an increase of 13.2 per cent over the number of passenger-miles flown in 1952.

* * *

During 1953 there was an impressive increase in the volume of traffic carried by S.A.S.: 669,905 passengers flew on the company's aircraft, 17.9 per cent more than in 1952. The increase was most marked on the inter-continental services, which carried nearly 105,000 passengers, representing an increase of 25.7 per cent. Cargo traffic went up by 10.3 per cent to 9,374 tons.

* * *

At Woolwich Magistrates' Court, on January 28th, summonses against the Evening Standard Co., Ltd., and against Mr. A. G. Green were adjourned until February 11th. The summonses allege that on September 11th last year the defendants—respectively operators and pilot of an S-51 helicopter—failed to comply with the Air Navigation Order of 1949 and caused unnecessary danger to persons and property by flying low over the Royal Arsenal, Woolwich.

* * *

Air transport movements at U.K. aerodromes last December totalled 12,500, some 6 per cent more than in December 1952. The total of passengers handled (202,100) went up by 13 per cent. London and Northolt together handled 106,100 passengers, an increase of 12½ per cent; 78,600 passengers (45 per cent more than in December 1952) used London Airport but passenger traffic at Northolt dropped by 31 per cent.

PLAISANCE AIRPORT, Mauritius, is a calling-point on the fortnightly "Wallaby" service flown between Sydney and Johannesburg by Qantas Empire Airways. Its single runway must be a particularly welcome sight on completion of the 2,600-mile westbound flight across the Indian Ocean from the Cocos Islands. Flying by night, the Constellation is scheduled to take just over 11 hr for this stage, the longest part of its inter-Commonwealth journey.

CIVIL AVIATION . . .

WE CALL ON LUFTAG

THERE is an air of austerity about No. 1, Claudiustrasse. All around are patches of devastation characteristic of post-war Cologne, and the building itself has the neglected appearance reminiscent of one of those large Victorian houses partly restored by English local governments for the dispensation of orange juice, cod liver oil and advice on housing. It is in fact a former university converted into offices, several of which are occupied by Luftag—to quote the abbreviated name of the company formed 12 months ago to prepare for the revival of Germany's national airline.

The full title is found engraved on a metal plate outside the building: *Aktiengesellschaft für Luftverkehrsbedarf*, which can be translated as Joint Stock Company for Air-traffic Supply. The second plate—"Deutsche Lufthansa in liquidation"—is in a sense misleading: it refers to the pre-war airline, whose name is eventually almost certain to be adopted by its successor.

First impressions are dispelled, however, on entering Luftag's offices—brightly lit, centrally heated, equipped with new furniture and decorated by coloured pictures of Comets and Convairs. The P.R.O., Herr Hallensleben, provided a courteous welcome and introduced us to Dipl. Ing. Hoeltje, technical director of Germany's embryo airline. The other top executives are the pre-war president of Lufthansa, Dr. Kurt Weigelt, and Herr H. M. Bongers, traffic director.

Ing. Hoeltje outlined for us the development of Luftag to date. It stems directly from the Bureau Bongers, formed in 1951 to prepare "the first rough sketches." Luftag itself was incorporated on January 6th, 1953, to buy equipment and build up the nucleus of an airline, in preparation for the day when German sovereignty is restored.

All efforts are at present directed towards reaching a state of readiness by July 1st—but here we must emphasize that this target date is purely arbitrary. Nobody—in or out of Germany—can predict with certainty when the Bonn Convention will be ratified. Until that occurs no German is allowed to fly powered aircraft and the Federal Government has no power to grant, withhold or exchange traffic-rights.

Luftag is a private company with capital of 25m marks (about £2m), of which the Federal Republic has provided about 75 per cent. Capital is to be doubled during 1954; we were unable to discover the amount to be added by the Government. There is a strong body of opinion favouring an increase in the proportion of private shareholding, but until the airline gets into its stride banking and industrial interests will be naturally reluctant to sink capital in an unproductive corporation. It is at least certain that Lufthansa will be a monopoly backed by both public and private money. Dr. Seebohm, Federal Transport Minister, has said that the German airline will have to face enough competition without setting up any domestic rivals.

A year ago it was the declared intention of the Government to equip the airline with an initial fleet of 24 aircraft, this total to be divided equally between the regional and the long-haul divisions. Last July it was reported that German attempts to secure a large American loan for this purpose had failed. We cannot vouch for the truth of this report, but there is no disputing the fact that shortly afterwards the proposed fleet was cut by two-thirds. After some hesitation, and high-pressure sales-drives by a number of manufacturers, orders were finally placed for four Convair 340s and a similar number of Super Constellations.

We asked Ing. Hoeltje why Luftag chose the Convair in preference to the Viscount, which, with its four turboprops, seemed a much more suitable choice. At a time when most European airlines are contemplating with some anxiety the costly but inevitable process of acquiring new and more competitive equipment, we reasoned, it seemed unnecessarily timid to start from scratch with piston engines. Delivery dates, he replied, were the prime consideration: the four Convairs would be ready for delivery between May and July, whereas Viscount 700s would not have been available until more than a year later. Another consideration was that Lufthansa's commercial inexperience would itself place the company at a disadvantage in competing with the other European airlines; so it was deemed wise to choose the most thoroughly proven equipment available. There was also the possibility that the small German fleet might initially be employed on very short stage-lengths, whereas the Viscount 700 was better suited to the longer routes of B.E.A.

At this point the Luftag executive emphasized that orders so far placed were of a preliminary nature only and that the airline was not tied to any particular type. The "stretched" Viscount 800, and latest modifications to the Dart turboprop, were developments which made the British turboprop airliner an even better proposition—on both short and long routes.

We gathered that Luftag expects little difficulty in recruiting suitable personnel. Already there is something more than a skeleton staff—a total of 200 employees, of whom engineering and operational staff comprise about 35 per cent; administration, traffic, communications, legal and clerical departments account for the remainder. Initial training of pilots is already in progress. Four former Lufthansa captains are studying for their commercial licences with A.S.T. at Hamble and a Link Trainer has been installed in Luftag's Cologne offices to ensure that a further intake of these veterans (30 pre-war German airline pilots have been recruited, all in their forties) will be capable of picking up the threads. The next move will be to take on about 20 former Luftwaffe transport pilots. All future German airline crews will be trained from the *ab initio* stage and it is intended to set up a school for this purpose.

The airline will be able to draw on German industry for a sufficient number of engineering personnel. An additional source of skilled labour is the large body of German technicians directly employed on aircraft by the occupying air forces or by the foreign airlines. Ing. Hoeltje is anxious to negotiate the largest possible number of interline agreements for joint servicing and pooling of spares and he is already arranging to send out German mechanics for technical courses of two or three weeks' duration in the workshops of other airlines. He was, incidentally, due to arrive in London last week to consult Mr. Beverley Shenstone, B.E.A.'s chief engineer, on this very subject.

Hamburg has been chosen as the future base of Lufthansa. Under construction there are two large hangars which should be capable of accommodating any type of aircraft ordered in the foreseeable future ("including the Comet 3 and Vickers 1000," said Ing. Hoeltje). The dimensions are: uninterrupted span, 360ft; height, 47ft; width, 165ft. Half the apron area has been laid, the foundations are down and some girders have been erected; as on most German industrial projects, work is going on day and night and the buildings are expected to be ready by the end of next month.

So far as future operations are concerned, all Luftag's planning hinges on one question as yet unanswered—when will the Bonn Convention be ratified? The same question is asked by the score of airline operators now exercising fifth- and sixth-freedom traffic rights at German airport, and, it is estimated, taking well over £12m annually in German currency.

These "guest" airlines, who will retain their present traffic rights until the Federal Republic has negotiated bilateral agreements with their respective governments, include Air France, B.E.A., B.O.A.C., K.L.M., P.A.W.A., Sabena, S.A.S., Swissair, T.C.A., T.W.A., and Qantas.

Lufthansa carried over 30 per cent of pre-war European air traffic, and was among the leaders in long-haul operations, but the process of regaining this status will be a gradual one. The small fleet ordered for the new Lufthansa will initially be used only on a few key routes. Regional services with Convairs will be inaugurated first, possibly between Hamburg and the capitals of Britain, France, Italy and Switzerland. When the four Super Constellations become available in the summer of 1955, it is intended to extend German services to the competitive but profitable North Atlantic route. Luftag's executives feel it would be a mistake to disperse their small number of aircraft over a large network, and the emphasis will at first be on frequency of service rather than variety of destination.

R. B.

CIVIL AVIATION . . .

CIRRUS-AUTOCAR SPRAYER

THE makers of the Autocar Sprayer, Auster Aircraft, Ltd., of Rearsby, Leicestershire, have issued new information about this, their latest, spraying product. Powered by a Cirrus Major 3 engine of 155 h.p., the aircraft has a considerable reserve of power which is useful for operation from unprepared strips and particularly for the safety factor it provides during spraying, both for making steep turns and in hilly or obstructed areas.

Two versions are available: a single-seater, carrying a 70 Imp. (85 U.S.) gallon tank; and a two-seater, intended for seasonal spraying duties, with a 48 Imp. (58 U.S.) gallon tank in the rear part of the cabin. The latter type can be used for ordinary flying duties outside the spraying season, and the passenger seat makes it particularly useful for anti-locust work, in which it is often advantageous to have an observer in addition to the pilot.

During spraying, the high-lift split flaps are set at take-off position. In addition to the aerodynamic advantage the turbulent downwash of slipstream helps to carry the spray to the underside crop leaves. The spray-boom, of 17ft span, has 20 nozzles, available in three different sizes. Spraying rate can be varied up to 3½ gallons per acre.

Leading Data for Autocar Sprayer at 2,520 lb a.u.w.:—Wing and power loadings (70-gal version), 13.6 lb/sq ft and 16.25 lb/h.p. respectively. Max. cruising speed 84 m.p.h. Landing run, 130 yd. Take-off run, 5 m.p.h. wind, 220 yd. Fuel consumption during spraying, 8 imp. gall/hr. Effective swath-width flying 5ft a.g.l., 45ft. Recommended spraying speed range, 50-75 m.p.h.

Auster J5G Autocar Sprayer, one of two purchased by the newly-formed French company Air-Agro-Maroc of Casablanca. (Below) The Riley Twin (two 150 h.p. Lycomings) is the outcome of engineering and conversion rights for modifying Ryan Navions. A contract with Riley Aircraft Sales Company calls for 100 conversions at the Temco Aircraft Corporation's Grenville factory by May of this year.

TWIN NAVION DEVELOPMENT

THE exclusive rights for the conversion of Ryan Navions to Riley Twin configuration has been acquired by Temco Aircraft Corporation of Dallas, Texas, from Dauby Equipment Co., of Los Angeles, California. Temco has already converted a considerable number of Navions; this transaction means that Dauby will now drop out of the group. Riley Aircraft Corporation will continue to handle sales and distribution of Temco-converted Riley Twins under a separate contract agreement.

The standard conversion requires 450 new parts, which are made by Temco. In addition, the company is now incorporating two further modifications; these are, first, 150 h.p. Lycoming engines (instead of 140 h.p.) with redesigned cowlings, larger spinners and improved exhaust system and, secondly, an increase of 400 lb in maximum all-up weight (to 3,350 lb) by structural and undercarriage strengthening. The useful load is thus increased to 1,000 lb; this does not include accessories and radio equipment.

R.Ae.C. DINNER TO RACING CHAMPION

BRITISH Air Racing Champion for 1953 was S/L. Jimmy Rush, A.F.C., and on January 27th a dinner was given at the Royal Aero Club in his honour and in that of the winner of the King's Cup, Pat Fillingham. Among those present in a full house was the Minister of Transport and Civil Aviation, Mr. Lennox-Boyd, who is also a member of the Club. Formally introduced by the chairman, Mr. Kenneth Davies, he congratulated S/L. Rush and presented the Championship Trophy. To this prize the Minister added one of his own—a cigar given to him by Mr. Churchill.

In an excellent speech following the presentation, Jimmy Rush spoke of the honour not only to himself and his family but to Newcastle. He recalled an occasion when, as a lad, he had talked to Capt. F. L. Barnard, who was taking part in the round-Britain King's Cup Race of 1925 (which he eventually won in his A.W. Siskin V). As a direct result of what was said, the lad determined that he would one day fly, and perhaps race.

S/L. Rush then referred to his early racing experiences and to those who had been responsible for the organization of the events. Especially he recalled the Isle of Man race and the work of W/C. Rex Stocken. He paid a tribute to the experts at the time he took up racing—Geoffrey de Havilland, Alex Henshaw, Tommy Rose and others; then, speaking of races of the last few years, he said that a special word of praise was due to the Swansea and District Flying Club. In spite of repeated bad luck with the weather, they were still running the Welsh Air Derby; they were a grand club.

The champion then went on to speak of the excellent work of the Royal Aero Club racing committee—and particularly that of Col. Preston—and referred, amid laughter, to the handicappers as "the rock on which air racing was based." However pent up one felt on the starting line, the presence of Philip Mayne with his flag and his smile of recognition as one's turn to take off came up, always made one feel better. (Earlier in the evening, incidentally, Mr. Mayne had "flagged-off" the dinner at the soup course.)

S/L. Rush referred to the young pilot who he has taken under his wing, and he suggested that each old hand should similarly sponsor a young man who was keen to fly. He concluded with the promise that, in spite of rumours of his impending retirement from air racing, he would defend his title this season.

Pat Fillingham was next called to his feet, and congratulated Jimmy Rush on a well deserved win—he had been racing longer than any of the others. Mr. Fillingham also proposed a toast in honour of the Kemsley Trust, without which there would be no racing and thus no dinner that evening.

Appropriately, the Throttle Benders' Union was well represented at the dinner, and in addition to Jimmy Rush we were pleased to note that Tony Cole, recently returned from Rhodesia, was present, with Somers, Dunkerley and Paine.

Col. Preston took advantage of the appropriate occasion to announce briefly the recipients of Royal Aero Club Trophies and Gold and Silver Medals for the year. These are listed, together with portraits, in the "From all Quarters" pages of this issue.

S/L. Jimmy Rush receives the British Air Racing Championship Trophy for 1953 from the Minister of Transport and Civil Aviation, Mr. Lennox-Boyd.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

FOR ROYAL VISITORS: The special R.A.A.F. Dakota for the use of the Queen during her stay in Australia. The crew are: S/L. J. G. Cornish (captain), Nursing Sister G. Bury (hostess), S/L. C. W. Brackenridge (navigator), F/L. T. C. McGrath (signaller) and P/O. J. R. Newson (co-pilot).

No. 6 Squadron Celebrates

DUAL celebrations held in Amman and London last Sunday marked the 40th anniversary of the formation of No. 6 Squadron, under Major J. W. H. Becke on January 31st, 1914. In Amman, where No. 6 is now based, the unit was presented with its Queen's Standard by the C-in-C. Middle East Air Force, Air Marshal C. B. R. Pelly. In London the celebrations took the form of a reunion dinner, under the chairmanship of W/C. D. Crowley-Milling, held at the Belfry Club.

Of the 40 years of its existence, No. 6 Squadron has spent no fewer than 35 abroad, mostly in the Middle East.

The guest of honour in London was Air Chief Marshal Sir William F. Dickson, the Chief of the Air Staff, and eight previous commanding officers were present, including Air Chief Marshal Sir Arthur Barratt, C.O. in 1916-17.

W/C. Crowley-Milling, proposing the toast of No. 6 Squadron, read a number of congratulatory messages, including one from the Prime Minister. Looking round the number of high-ranking officers present, he observed that No. 6 Squadron had always been known as "the nursery of the Air Staff." He then gave the toast—"No. 6 Squadron, one of the oldest units in the youngest service."

S/L. P. A. Kennedy, who replied, gave a brief résumé of the squadron's history, stressing particularly the period from El Alamein onwards when the unit did such remarkable work on their Hurricane 2Ds with 40 mm cannon. This brought them the name of "Flying Tin-openers" (a winged tin-opener was suspended over the top table at the Belfry Club). He said the squadron has achieved a quite unbeatable record of service in the Middle East and remarked that it is soon to have its Vampires replaced by Venoms.

Lord Dowding and Sir Arthur Barratt both gave accounts of what service was like in No. 6 in what Sir Arthur termed the "pre-deluge" period. Lord Dowding gave the assembled company a very clear picture of life in the Royal Flying Corps in France in 1914 and Sir Arthur discussed at some length the military virtues—or otherwise—of the B.E.2C and the R.E.8. He refused, however, to make any comment on a certain landing made in a tree by one Capt. A. S. Barratt.

Sir William Dickson, speaking for the R.A.F., was at his very best. He praised No. 6 Squadron for its continued maintenance of an offensive spirit and recalled how in the last war No. 83 Group learned its work from the Desert Air Force, which in its turn had got it from No. 6 Squadron. Referring to those today who had a "Maginot Line" outlook, he said that No. 6 Squadron's strategy of "taking the war into the other chap's country" was the right one. He made it known that he was shortly going to the Middle East and would call on the squadron at Amman. Sir William also referred in a very appreciative manner to *Flight's* history of No. 6 Squadron. (Sketches of the unit's aircraft from this history were used to decorate the menu card.)

At the tables anecdotes were being told on all sides, many of them being brought to mind as guests looked through the squadron albums which, with some of the silver, had been brought to Britain for the occasion. The best we overheard was of a pilot who landed by the side of a scarecrow to ask the way!

No. 6 Squadron has a number of war honours, some earned in the Middle East between the wars. These M.E. honours are not allowed to go on the Standard; those selected are: Western Front, 1914-18; Neuve Chapelle; Ypres, 1915; Somme, 1916; Amiens, Hindenburg Line; Egypt and Libya, 1940-43; El Alamein; Italy, 1944-45. J. Y.

COMMANDERS AND A GUEST: A group of commanding officers of No. 6 Squadron with the Chief of the Air Staff. (See "No. 6 Squadron Celebrates".) Front row: A. Cdre. H. M. Massey, Air Chief Marshall Sir William F. Dickson, Air Chief Marshal Sir Arthur Barratt and A. Cdre. A. G. Adnams. Back row: S/L. P. A. Kennedy, S/L. R. H. Langdon Davies, A. Cdre. C. R. Cox, A. Cdre. W. E. G. Mann and W/C. D. Crowley-Milling. "Flight" photograph

R.A.F. Cresta Wins

ON the Cresta Run last Saturday the R.A.F. won the race for four-rider teams with an aggregate time of 429.4 sec, the Army's time was 433.1 sec and the Navy's 440.6 sec.

F/L. C. M. C. Mitchell, with a near-record time of 45.8 sec easily held the Inter-Services Skeleton Championship, which he won last year, and was awarded the Lord Trenchard Challenge Cup.

The course was 856 yards long, with a drop of 332 feet.

Handley Page Recognition Trophy

THE winners in the Handley Page Trophy aircraft recognition competition, held in the Science Museum on January 30th (see *Flight*, January 29th) were the Metropolitan Area R.O.C. team, with 134 points out of 150; runners-up were the R.A.F. St. Eval "B" team, Coastal Command, with 126 points. Highest individual scorer was F/O. L. Naile, of R.A.F. Linton-on-Ouse, who gained 48 points out of 50. A photograph of the trophy appears overleaf.

Jet Accident Rate

KEEN appreciation of the true facts about the accident rate in the Royal Air Force was shown in the House of Commons last week when, in reply to a question by Col. Sir Leonard Ropner (Con., Barkston Ash), it was stated by Mr. George Ward, Under-Secretary for Air, that in the United Kingdom in 1953 there were 91 fatal accidents to R.A.F. jet aircraft in which 112 personnel lost their lives. These figures were slightly lower than the comparable figures for 1952, although the number of hours flown during the year was about one-third greater.

Sir Leonard wondered whether training should not be extended on slower and "easier" aircraft over a longer period before young pilots were allowed to fly jet types.

Mr. Ward did not think that was the

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answer. On the contrary, it might well be that the step from the slower light aircraft to the jet was too big. He drew attention to the introduction of the Provost/Vampire training sequence and added that the introduction as an experiment of a basic jet trainer was being considered.

Mr. Frank Beswick (Lab., Uxbridge) asked whether it could be said what proportion of accidents was caused by human error, and whether there was any structural cause to account for a significant number of accidents.

Mr. Ward thought it quite impossible to put one's finger on any one feature that was common to all accidents.

Mr. Philip Noel-Baker (Lab., Derby South) asked how the figures of jet accidents compared with fatal accidents in piston-engined types.

Mr. Ward replied that the fatality-rate in jet accidents during 1953 was roughly one-half of the lowest fatal-accident rate for the Spitfire when in comparable service.

This statement made an extremely favourable impression on the House, and the loud cheering that followed was clearly intended as a tribute to the high standard of flying instruction and airmanship in the Royal Air Force.

Training-Carrier Changes

COMPREHENSIVE changes in the employment of our available aircraft carriers are announced by the Admiralty. The principal alteration is the substitution by light fleet carriers of the fleet carriers now forming the Home Fleet Training Squadron. The squadron at present consists of H.M.S. *Implacable* (flagship of Rear-Admiral W. L. G. Adams, O.B.E., Flag Officer Training Squadron) and H.M.S. *Indefatigable*.

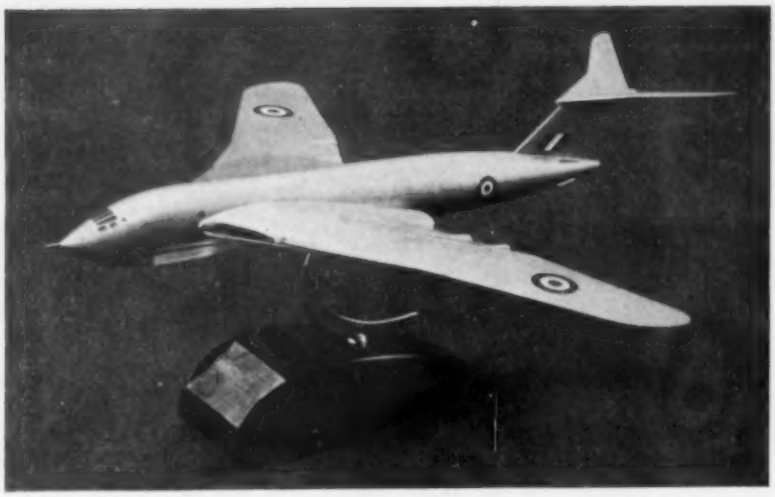
The replacement will be by three Colossus class ships: H.M.S. *Theseus*, now Home Fleet; H.M.S. *Glory*, at present in the Mediterranean; H.M.S. *Ocean*, now at Devonport, where she returned at the end of last year after two-and-a-half years' service in the Far East.

These Colossus class carriers are to be fitted out as instructional ships in H.M. Dockyards and will eventually be replaced in the peacetime seagoing fleet by the new Hermes class, three of which—*Centaur*, *Albion*, and *Bulwark*—are nearing completion. *Centaur* is now in Portsmouth dockyard being fitted with the new "angled" deck and will be the first of the new class to go into service.

The changeover will take some time. Alterations to *Ocean* and *Theseus* will be started immediately and these two ships are expected to be ready to relieve *Implacable* in June. Work on *Glory* will start in August and she should join the Training Squadron by about mid-November, freeing *Indefatigable* for other duties.

The changeover from fleet to light fleet carriers will have the effect of bringing to the Training Squadron three light aircraft carriers capable of being rapidly brought into operational service for trade protection in an emergency, and of making some of the men now serving in the fleet carriers available to man the new Hermes-class ships, and ultimately the new *Ark Royal*, now building at Birkenhead.

The Training Squadron normally provides initial sea training for more than a thousand General Service and National Service personnel of executive and specialist branches and some men who have been selected for commissions from the lower deck (Upper Yardmen). The squadron is based at Portland but frequently undertakes short cruises and participates in exercises with the Home Fleet. In March, *Implacable* and *Indefatigable* will leave the United Kingdom on their final cruise as ships of the Training Squadron. They will visit Gibraltar and take part in exercises in the Western Mediterranean, returning to Portland early in April.



RECOGNITION TROPHY: The 20-inch-span model of the H.P. Victor presented by Sir Frederick Handley Page as a trophy for the annual R.A.F. aircraft recognition contest. Results appear on page 167.

R.Aux.A.F. Appointment

THE appointment is announced of S/L. S. Kirtley to command No. 611 (West Lancashire) Squadron, R.Aux.A.F., at Hooton Park, Little Sutton, Wirral.

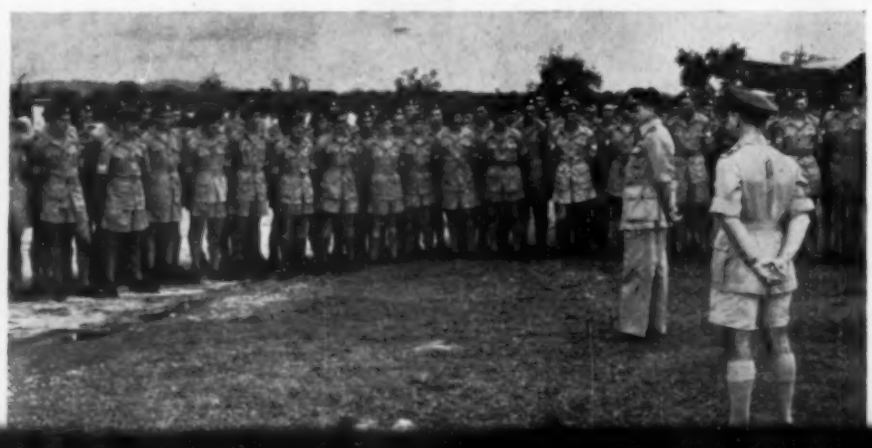
S/L. Kirtley, who is a Regular officer, joined the R.A.F.V.R. as a wireless operator/air gunner in 1940 but remustered for pilot training and was commissioned in 1941. His wartime service included a spell of duty as an instructor in Alabama and at No. 5 (Pilots) A.F.U. in Britain; all his operational flying was with No. 118 Squadron.

Since the war S/L. Kirtley has had a number of varied appointments including more instructing and an overseas tour.

Reunions

THE eighth annual reunion dinner of No. 780 R.N. Squadron is arranged for Friday, March 19th, and will be held at Simpsons in the Strand, London. Details from Cdr. J. Goodyear, Northolt Airport, Ruislip, Middlesex.

To celebrate the 21st anniversary of the founding of the R.A.F. Yacht Club, a dinner and dance is to be held at the Hyde Park Hotel, Knightsbridge, London, S.W.1, on Friday, March 19th. Tickets—two guineas each—may be had from the Secretary, R.A.F. Yacht Club, Riverside House, Hamble, Southampton.



COMMONWEALTH LINKS: (Left) Mr. A. J. Black, Director of Studies, R.A.A.F. College, Point Cook, visits Cranwell. With him are A. Cdre. H. Eeles, Commandant, and Mr. A. Constant, Director of Studies at the R.A.F. College. (Below) Air Marshal Sir Clifford Sanderson, C-in-C. Far East Force, bids farewell to No. 83 Squadron at Tengah airfield, Malaya, before the unit started on its journey to Britain. With his back to the camera is the C.O., S/L. W. C. Sinclair, A.F.C. No. 83 Squadron's duties in Malaya have been taken over by No. 7 Squadron (S/L. D. S. Saunders).

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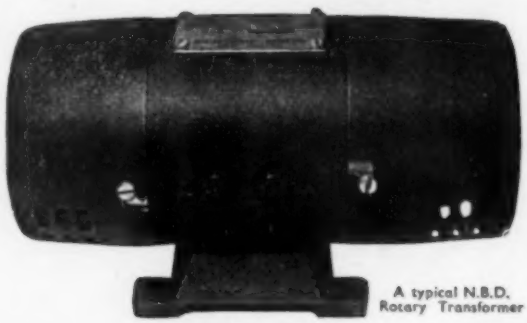

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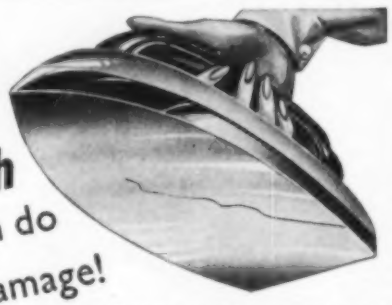

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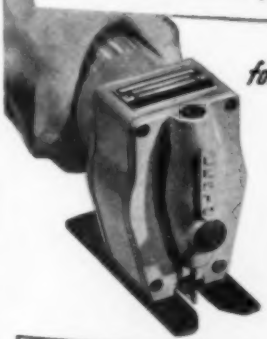

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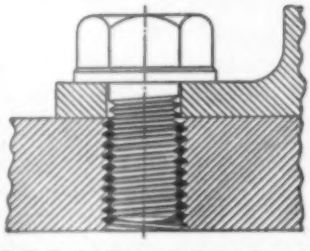

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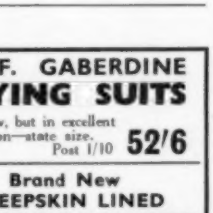

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

From: Hunting-Clan Air Transport, Ltd., of 5 Fitzhardinge Street, London, W.1:

Application No. 260. For an inclusive tour service with Viking and Dakota aircraft for the carriage as passengers of members of the Holiday Fellowship and Co-operative Holiday Association between London (Bovingdon) and Basle (Mulhouse) at a frequency of one service fortnightly, during the period from May 30th to August 22nd, 1954, inclusive.

Application No. 261. For an inclusive tour service with Viking and Dakota aircraft for the carriage of passengers as in Application No. 260 between London (Bovingdon) and Munich at a frequency of one service fortnightly during the period from June 6th to August 29th, 1954, inclusive.

Application No. 262. For an inclusive tour service with Viking and Dakota aircraft for the carriage of passengers as in Application No. 260 between London (Bovingdon) and Nice (Le Var) at a frequency of one service fortnightly during the period from June 13th to August 22nd, 1954, inclusive.

Application No. 263. From Transair, Ltd., of Croydon Airport, Surrey, for an inclusive tour service with Dakota aircraft for the carriage of children and accompanying adults only for Riviera Holiday Schools, between London (Croydon or Gatwick) and Nice (Le Var) at a frequency of from seven to 11 services during the period from July 29th to September 9th, 1954, inclusive.

Application No. 264. From Hunting-Clan Air Transport, Ltd., of 5 Fitzhardinge Street, London, W.1, for a Colonial coach service with Viscount aircraft for the carriage of passengers and supplementary freight between London and Singapore and between London and Hong Kong, the latter initially by connection arranged by Hunting-Clan Air Transport, Ltd., with their proposed Singapore service at Bangkok and thereafter by a through service, with intermediate traffic stops at Malta and Nicosia for traffic to and from Singapore and Hong Kong only at an initial frequency of one return service to Singapore each fortnight, later increasing in accordance with traffic demand up to one return service weekly each to Singapore and to Hong Kong during a period of 10 years from April 1st, 1955.

Application No. 265. From Silver City Airways, Ltd., of 1 Great Cumberland Place, London, W.1, for a special normal scheduled service with Dakota and Bristol 170 aircraft for the carriage of passengers and freight between London (Blackbushe) or Ferryfield and Baghdad West on 10 flights in each direction in connection with the British Trade Fair, Baghdad, during the period from September 1st to November 30th, 1954.

THESE applications will be considered by the Council under the terms of reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing, stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 9 Buckingham Gate, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [1598

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The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

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SIERRA LEONE Government Civil Aviation Department for one tour of 18-24 months, with prospect of permanency. Salary (etc.) according to qualifications and experience in scale £742 rising to £1,177 a year. Outfit allowance £60. Liberal leave on full salary. Free passages for officer and wife. Assistance towards cost of children's passage or grant of up to £150 annually for maintenance in U.K. Candidates should be experienced in M.F., H.F., V.H.F. and V.H.F./D.F. and ancillary equipment, and should hold the P.M.G. certificate in wireless telegraphy or equivalent. Preference will be given to those holding City and Guild certificates in radio.—Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience, and quote M2C/30353/F.E. [1588

A. V. ROE AND CO., Ltd., have the following vacancies in their Technical Publications Department.
(a) Technical authors are required for the preparation of descriptive and servicing manuals, servicing schedules, pilots' notes, etc. Candidates should have had experience of aircraft servicing and maintenance and special consideration will be given to ex-R.A.F. personnel who are Halton trained men. Applications are particularly required from men with electrical experience.
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OPPORTUNITIES exist for first-class senior and intermediate airframe stressmen in the development of new projects. Permanent posts at good salaries for suitable applicants.—Applications, in writing, should state age, experience and salary expected, and be addressed to the Chief Designer, Auster Aircraft Ltd., Rearsby Aerodrome, Leicester. [1518

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WRITE, stating age and full details, to Staff Officer, Handley Page, Ltd., Cricklewood, London, N.W.2. [1558

SAUNDERS-ROE, Ltd., would be pleased to hear from aeronautical draughtsmen interested in employment in the Isle of Wight.
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APPLY, stating age, salary, experience, etc., and quoting reference F/2, to the Personnel Officer, Saunders-Roe, Ltd., East Cowes, I.O.W. [1590

WANTED, qualified Dakota captain, 1st officers. Full details to Starways, Limited, Liverpool Airport, Liverpool 19. [1596

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DESIGN draughtsmen required by R.F.D. Co., Ltd., Godalming. Must be experienced in mechanical engineering or rubberized fabric technology. Practical experience and technical qualifications essential. [1579

A VACANCY exists for a senior man in the electrical design section of Saunders-Roe, Ltd. Applicants for this post should have good aircraft drawing office experience and qualifications up to A.M.I.E.E. standard.
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REQUIRED immediately by Percival Aircraft, Ltd., Luton Airport, Beds, several draughtsmen with comprehensive experience of engine installation and allied systems. Good welfare facilities, including staff pensions scheme.—Applications in writing, stating age, qualifications, experience and salary required to the Personnel Manager. [0601

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NORMALAIR, Ltd., invite applications from draughtsmen for work on aircraft pressurization and high altitude breathing equipment in their Yeovil and Cricklewood drawing offices. Applicants should be of Higher National Certificate standard. A generous superannuation scheme is in operation.—Applications, in the first instance, should be addressed to the Personnel Officer, Normalair, Ltd., Yeovil. Local interviews arranged where convenient. [1571

SENIOR aerodynamicist required. Minimum qualifications B.Sc. or equivalent and five years experience, should be able to undertake stability and control calculations, performance estimates and data for stressing. Also a junior aerodynamicist with sound knowledge of aerodynamics and preferably some experience.—Applications, in writing, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds, stating age, experience, previous position held and salary required. [1504

THE Navigational Project Division of The English Electric Co., Ltd., Luton, require technical supervisory mechanical engineers for their project offices. Senior aerodynamicists are also needed to carry out performance assessment and other interesting work. Preference will be given to graduate engineers who have had some administrative experience in the aircraft and other associated industries. These are senior appointments carrying appropriate salary.—Apply to Dept. C.P.S., 336-7 Strand, W.C.2, quoting Ref. 1240. [1595

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DESIGNERS, stressmen, weight estimators and aerodynamicists required to work in new design office at Farnborough, Hants. Only first-class men should apply.—Applications, which will be treated as confidential, should state experience, qualifications and salary required, and be addressed to the Chief Designer, Auster Aircraft, Ltd., Rearsby Aerodrome, Leicester. [1560

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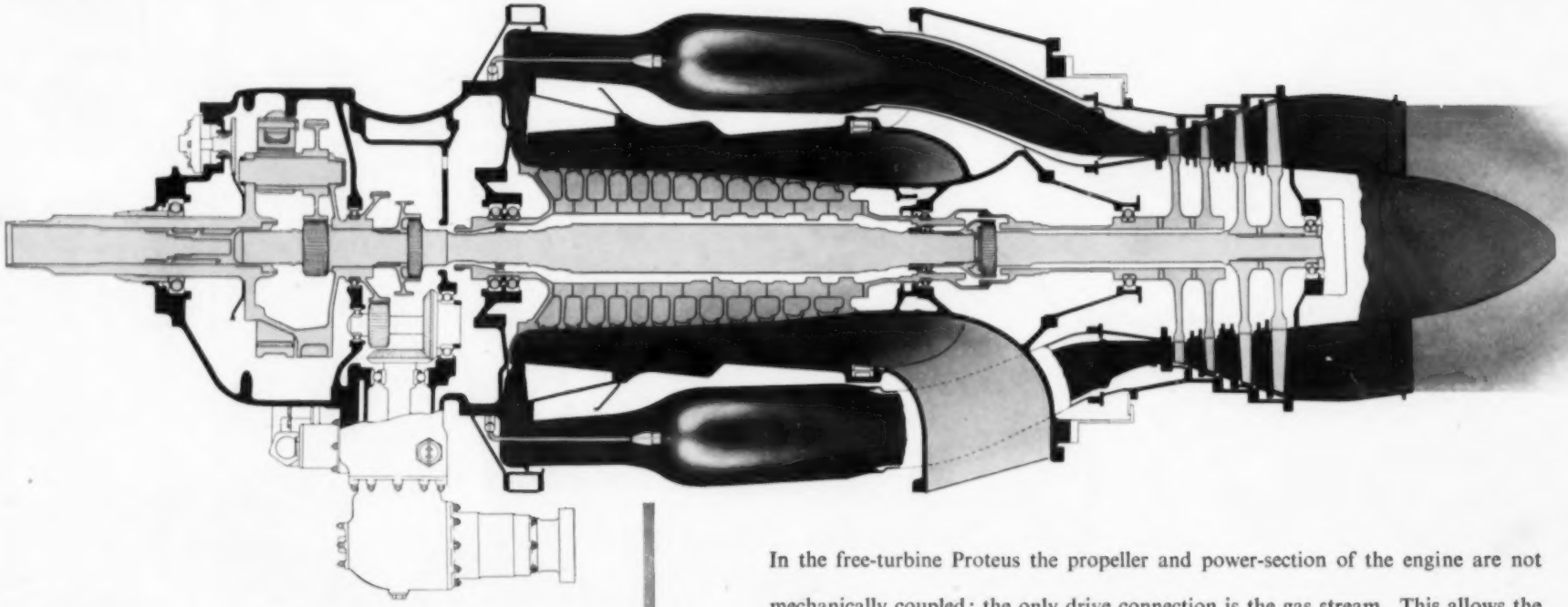

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